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Nothrotherium shastense Sinclair.
Restoration by Charles R. Knight under direction of Chester Stock.

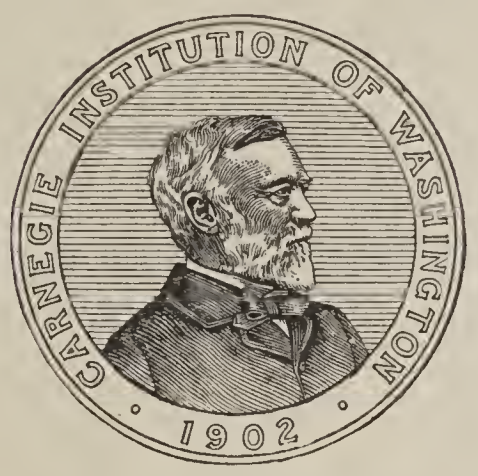
CENOZOIC GRAVIGRADE EDENTATES OF WESTERN NORTH AMERICA

WITH SPECIAL REFERENCE TO

THE PLEISTOCENE MEGALONYCHINAE AND MYLODONTIDAE OF RANCHO LA BREA

BY

CHESTER STOCK



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Frontispiece. *Nothrotherium shastense* Sinclair. Restoration by Charles R. Knight under direction of Chester Stock.

PLATE 1A.

View looking north showing Los Angeles Museum pits 61 and 67, Rancho La Brea. Photograph by L. E. Wyman. Courtesy of Los Angeles Museum.

1B.

View looking northeast showing final stage in removal of wall separating Los Angeles Museum pits 61 and 67, Rancho La Brea. Photograph by L. E. Wyman. Courtesy of Los Angeles Museum.

PLATE 2.

Nothrotherium shastense Sinclair.

FIGS. 1 and 2. Skull, No. 1800–11, dorsal and ventral views; ×0.44.
FIGS. 3 and 4. Skull and mandible, No. 1800–11 and No. 1801–7, anterior and posterior views; × 0.44.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 3.

Nothrotherium shastense Sinclair.

FIGS. 1, 2, and 3. Endocranial cast. Fig. 1, dorsal view; fig. 2, lateral view; fig. 3, ventral view; × 0.75.
Los Angeles Museum Collection.

Hapalops sp.

FIGS. 4, 5, and 6. Endocranial cast. Fig. 4, dorsal view; fig. 5, lateral view; fig. 6, ventral view; × 0.75.
Los Angeles Museum Collection.

PLATE 4.

Nothrotherium shastense Sinclair.

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Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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Nothrotherium shastense Sinclair.

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Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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Nothrotherium shastense Sinclair.

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Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 7.

Nothrotherium shastense Sinclair.

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Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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Nothrotherium shastense Sinclair.

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FIG. 4. Right clavicle, No. 1878–R–2, anterior view; × 0.50.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 9.

Nothrotherium shastense Sinclair.

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Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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Nothrotherium shastense Sinclair.

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Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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Nothrotherium shastense Sinclair.

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Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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Nothrotherium shastense Sinclair.

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FIGS. 2 and 3. Left patella, No. 1895–L–1. Fig. 2, femoral view; fig. 3, anterior view; × 0.50.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 13.

Nothrotherium shastense Sinclair.

FIGS. 1 and 2. Left femur, No. 1871–L–1. Fig. 1, posterior view; fig. 2, inner view; × 0.50.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 14.

Nothrothcrium shastense Sinclair.

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Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 15.

Nothrothcrium shastense Sinclair.

FIGS. 1 and 2. Right pes. Fig. 1, dorsal view; fig. 2, inner view; × 0.50.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 16.

Nothrothcrium shastense Sinclair.

Mounted skeleton, viewed from right side; × 0.094.
Los Angeles Museum Collection. Prepared by J. W. Lytle. Photograph by L. E. Wyman. Courtesy of Los Angeles Museum.

PLATE 17.

Megalonyx jeffersonii californicus Stock.

FIGS. 1 and 2. Mandible, No. 21429. Fig. 1, dorsal view; fig. 2, view of left side; × 0.50.
University of California Collection. Rancho La Brea Pleistocene.

PLATE 18.

Megalonyx jeffersonii californicus Stock.

FIGS. 1, 1*a*, and 2. First thoracic vertebra, No. 22111 U. C. C. Fig. 1, anterior view; fig. 1*a*, ventral view; fig. 2, lateral view; × 0.33. *az*, anterior zygapophysis; *c. f.*, facet for capitulum of rib; *t. f.*, facet for tuberculum of rib.
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Los Angeles Museum and University of California Collections. Rancho La Brea Pleistocene.

PLATE 19.

Megalonyx jeffersonii californicus Stock.

FIGS. 1, 1*a*, and 1*b*. Left humerus, No. 21003. Fig. 1, anterior view; fig. 1*a*, view of proximal end; fig. 1*b*, view of distal articulation; × 0.50.
FIG. 2. Left humerus, No. 21003, inner view; × 0.50.
University of California Collection. Rancho La Brea Pleistocene.

PLATE 20.

Megalonyx jeffersonii californicus Stock.

FIGS. 1, 2, and 3. Left ulna, No. 23192. Fig. 1, outer view; fig. 2, inner view; fig. 3, radial view; × 0.50.
University of California Collection. Rancho La Brea Pleistocene.

PLATE 21.

Mylodon harlani Owen.

Dermal ossicles; × 1.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 22.

Mylodon harlani Owen.

Skull, No. 1717–32, dorsal view; × 0.40.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 23.

Mylodon harlani Owen.

FIG. 1. Skull, No. 1717–32, ventral view; × 0.40.
FIG. 2. Premaxillaries, ventral view; × 0.40.
FIG. 3. Right incus; × 2.
FIG. 4. Left malleus; × 2.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 24.

Mylodon harlani Owen.

Skull and mandible, No. 1717–32 and No. 1718–1, lateral view; × 0.40.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 25.

Mylodon harlani Owen.

FIGS. 1 and 2. Skull and mandible, No. 1717–32 and No. 1718–1. Fig. 1, anterior view; fig. 2, posterior view; × 0.40.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 26.

Mylodon harlani Owen.

FIGS. 1, 2, and 3. Endocranial cast. Fig. 1, dorsal view; fig. 2, lateral view; fig. 3, ventral view; × 0.75.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 27.

Mylodon harlani Owen.

FIG. 1. Mandible, No. 1718–1; dorsal view; × 0.40.
FIG. 2. Hyoid arch, lateral view; × 0.40. *Sh*, stylohyal; *eh*, epiphyal; *ch*, ceratohyal; *bh*, basihyal; *th*, thyrohyal; *tc*, ossified thyroid cartilage.
FIGS. 3 and 4. Cervical vertebrae I to VII. Fig. 3, dorsal view; fig. 4, lateral view; × 0.25.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 28.

Mylodon harlani Owen.

Thoracic vertebrae; × 0.20.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 29.

Mylodon harlani Owen.

Caudal vertebrae and haemapophyses. Figs. 1 and 2, × 0.20; figs. 3 to 7; × 0.50.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 30.

Mylodon harlani Owen.

Sternal segments and sternal ribs; × 0.25.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 31.

Mylodon harlani Owen.

FIGS. 1 and 1*a*. Right scapula, No. 1715–R–15. Fig. 1, outer view; fig. 1*a*, view of proximal end; × 0.33.
FIG. 2. Right clavicle, No. 1738–R–1, anterior view; × 0.33.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 32.

Mylodon harlani Owen.

FIGS. 1 and 1*a*. Right humerus, No. 1712–R–1. Fig. 1, posterior view; fig. 1*a*, view of proximal end; × 0.33.
FIGS. 2 and 2*a*. Right humerus, No. 1712–R–1. Fig. 2, anterior view; fig. 2*a*, view of distal end; × 0.33.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 33.

Mylodon harlani Owen.

FIGS. 1, 2, and 3. Right ulna, No. 1714–R–27. Fig. 1, outer view; fig. 2, inner view; fig. 3, radial view; × 0.33.
FIGS. 4, 4*a*, and 4*b*. Right radius, No. 1713–R–3. Fig. 4, anterior view; fig. 4*a*, view of proximal articulation; fig. 4*b*, view of distal end; × 0.33.
FIG. 5. Right radius, No. 1713–R–3, ulnar view; × 0.33.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 34.

Mylodon harlani Owen.

FIG. 1. Right manus, dorsal view; × 0.33. *Cu*, cuneiform; *lu*, lunar; *un*, unciform; *mg*, magnum; *tr*, trapezoid; *tm*, trapezium; *mc* I, first metacarpal; I, II, III, IV, V, digits.
FIG. 2. Right manus, palmar view; × 0.33. *Pi*, pisiform; *s* and *s'*, sesamoid bones of the third and fourth metacarpals.
FIG. 3. Right manus, inner view; *sc*, scaphoid; remaining letters and numerals as in other figures; × 0.33.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 35.

Mylodon harlani Owen.

Pelvis, No. 1719–1, anterior view; × 0.20.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 36.

Mylodon harlani Owen.

Pelvis, No. 1719–1, posterior view; × 0.20.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 37.

Mylodon harlani Owen.

FIGS. 1 and 2. Pelvis, No. 1719–1. Fig. 1, lateral view; fig. 2, dorsal view; × 0.20.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 38.

Mylodon harlani Owen.

FIGS. 1, 1*a*, and 1*b*. Right femur, No. 1704–R–15. Fig. 1, anterior view; fig. 1*a*, view of proximal end; fig. 1*b*, view of distal end; × 0.33.
FIGS. 2 and 3. Right patella, No. 1710–R–15. Fig. 2, femoral view; fig. 3, anterior view; × 0.33.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 39.

Mylodon harlani Owen.

FIGS. 1 and 2. Right femur, No. 1704–R–15. Fig. 1, posterior view; fig. 2, inner view; × 0.33.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 40.

Mylodon harlani Owen.

FIGS. 1, 1*a*, and 1*b*. Right tibia, No. 1702–R–5. Fig. 1, anterior view; fig. 1*a*, view of proximal end; fig. 1*b*, view of distal end; × 0.33.
FIG. 2. Right tibia, No. 1702–R–5, inner view; × 0.33.
FIGS. 3 and 4. Right fibula, No. 1703–R–7; fig. 3, tibial view; fig. 4, outer view; × 0.33.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 41.

Mylodon harlani Owen.

FIGS. 1, 2, and 3. Right pes. Fig. 1, dorsal (outer) view; fig. 2, inner (dorsal) view; fig. 3, plantar (inner) view; × 0.33. *Ca*, calcaneum; *as*, astragalus; *cu*, cuboid; *na*, navicular; *ec*, ectocuneiform; *mc*, mesocuneiform; *mt.* II, *mt.* V, second and fifth metatarsals; II, III, IV, V, digits.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 42.

Mylodon harlani tenuiceps Stock.

FIG. 1. Ventral, posterior, and dorsal views of skull, No. 1716–1.

Mylodon harlani Owen.

FIGS. 2, 3, and 4. Same views as in fig. 1. Fig. 2, No. 1717–1; fig. 3, No. 1717–8; fig. 4, No. 1717–22.
Los Angeles Museum Collection. Rancho La Brea Pleistocene. Photographs by L. E. Wyman. Courtesy of Los Angeles Museum.

PLATE 43.

Mylodon harlani Owen. Figs. 1 to 4. Mandibles, dorsal and lateral views. Fig. 1, No. 1718–20; fig. 2, No. 1718–21; fig. 3, No. 1718–29; fig. 4, No. 1718–3.
Mylodon harlani tenuiceps Stock. Fig. 5, skull, No. 1716–1, lateral view.
Mylodon harlani Owen. Figs. 6, 7, and 8, skulls, Nos. 1717–1, 8, 22, lateral views.
Los Angeles Museum Collection. Rancho La Brea Pleistocene. Photographs by L. E. Wyman.

PLATE 44.

Mylodon harlani Owen.

Mounted skeleton, viewed from right side; × 0.077.
Los Angeles Museum Collection. Prepared by J. W. Lytle. Photograph by L. E. Wyman. Courtesy of Los Angeles Museum.

PLATE 45.

Mylodon harlani Owen.

Restoration by Charles R. Knight under the direction of Chester Stock.

PLATE 46.

Mylodon harlani Owen.

Replica of footprints in Pleistocene deposits at the Nevada State Penitentiary, Carson City, Nevada. Diagram indicates size of imprints, length of stride, and width of straddle. *a*, possible impression of ungual phalanx, digit III, manus. Cast prepared by J. W. Lytle. Los Angeles Museum Collection.

PLATE 47.

Mylodon harlani Owen.

FIGS. 1 to 6. Footprints on floor of tunnel in east wall of prison yard, Nevada State Penitentiary, Carson City, Nevada.

TEXT-FIGURES.

Fig. 1.—Chart showing geologic and geographic distribution of the Megalonychinae and Mylodontidae.

Fig. 2.—*A* to *G*, ground-sloth remains from Tertiary beds of Western North America. *A*, *B*, and *C*, ungual phalanx, No. 1096 U. C. C., from Rattlesnake formation, Eastern Oregon; *D* and *E*, tooth, No. 22110 U. C. C. from Pinole Tuff-Orinda-Siesta deposits, middle California; *F* and *G*, metapodial, No. 22900 U. C. C., from Rattlesnake formation, Eastern Oregon. All figures × 1.

Fig. 3.—Topographic map of Rancho La Brea showing location of principal excavations of the University of California and Los Angeles Museum.

Fig. 4.—*A*, *Nothrotherium shastense* Sinclair. A^1, *Hapalops* sp. Skeletons shown in lateral view and to same scale. A^1 after Matthew.

Fig. 5.—*Nothrotherium shastense* Sinclair. Skull, dorsal view. × 0.33. *n*, nasal; *mx*, maxillary; *l*, lachrymal; *lf*, lachrymal foramen; *fr*, frontal; *ma*, malar; *sq*, squamosal; *pa*, parietal; *so*, supra-occipital. Rancho La Brea Pleistocene.

Fig. 6.—*Nothrotherium shastense* Sinclair. Skull, ventral view. × 0.33. *mx*, maxillary; *anf*, antorbital foramen; *ma*, malar; *pl*, palatine; *ple*, palatine canal; *sq*, squamosal; *pt*, pterygoid; *s*, pterygoid sinus; *opt*, orifice of pterygoid sinus; *per*, periotic; *bs*, basisphenoid; *bo*, basioccipital; *flm*, foramen lacerum medum; *flp*, foramen lacerum posterius; *stp*, stylohyal process; 2, 5, second and fifth superior teeth. Rancho La Brea Pleistocene.

Fig. 7.—*Nothrotherium shastense* Sinclair. Skull, lateral view. × 0.33. 3, third superior tooth; *fr*, foramen rotundum; *fo*, foramen ovale; remaining letters as in other figures. Rancho La Brea Pleistocene.

Fig. 8.—*Nothrotherium shastense* Sinclair. Skull, posterior view. × 0.33. Letters as in other figures. Rancho La Brea Pleistocene.

Fig. 9.—*A*, *Nothrotherium shastense* Sinclair. A^1, *Hapalops longiceps* Scott. Skull and mandible, lateral view. × 0.33. A^1 adopted and reversed from Scott.

Fig. 10.—*A*, *Nothrotherium shastense* Sinclair. A^1, *Pronothrotherium typicum* Ameghino. A^2, *Hapalops longiceps* Scott. Ventral view of skull. A^1 after Rovereto; A^2, after Scott.

Fig. 11.—*Nothrotherium shastense* Sinclair. Vertical longitudinal section of skull, No. 1806. × 0.33. *n*, nasal; *fr*, frontal; *s*, frontal sinus; *pa*, parietal; *so*, supraoccipital; *per*, periotic; *bo*, basioccipital; *bs*, basisphenoid; *ps*, presphenoid; *pt*, pterygoid; *opt*, orifice of pterygoid sinus; *vo*, vomer; *pl*, palatine; *mx*, maxillary, *mxt*, maxillo-turbinal; *et*, ethmo-turbinals; IX, X, XI, foramen lacerum posterius; XII, condylar foramen.

Fig. 12.—*A*, *Nothrotherium shastense* Sinclair. A^1, *Pronothrotherium typicum* Ameghino; A^2, *Hapalops longiceps* Scott. Dorsal view of mandible. × 0.33. A^1, after Rovereto; A^2, after Scott.

Fig. 13.—*Nothrotherium shastense* Sinclair. Superior dentition. Lateral and occlusal views. × 1.

Fig. 14.—*Nothrotherium shastense* Sinclair. Inferior dentition. Lateral and occlusal views. × 1.

Fig. 15.—*A*, *Nothrotherium shastense* Sinclair; A^1, *Hapalops* sp. Views showing relation of size of endocranium to that of skull. × 0.33.

Fig. 16.—*Nothrotherium shastense* Sinclair. *A*, *B*, *C*, outer, anterior, and inner views of right half of second haemapophysis, No. 1919–R–1. *D*, *E*, *F*, outer, anterior, and inner views of right half of fourth haemapophysis, No. 1921–R–1. × 0.50. Rancho La Brea Pleistocene.

Fig. 17.—*Nothrotherium shastense* Sinclair. Fifth haemapophysis, No. 1922–1. × 0.50. *A*, anterior view; *B*, outer view; *C*, posterior view; *D*, dorsal view; *E*, ventral view. Rancho La Brea Pleistocene.

Fig. 18.—*Nothrotherium shastense* Sinclair. Sixth haemapophysis, No. 1923–1. × 0.50. *A*, outer view; *B*, posterior view. Rancho La Brea Pleistocene.

Fig. 19.—*Nothrotherium shastense* Sinclair. Ninth haemapophysis, No. 1926–1. × 0.50. *A*, dorsal view; *B*, outer view; *C*, ventral view. Rancho La Brea Pleistocene.

Fig. 20.—*Nothrotherium shastense* Sinclair. Sternal segments; anterior, ventral, and right side views. × 0.50. *A*, *B*, *C*, second segment, No. 1896–1; *D*, *E*, *F*, third segment, No. 1897–1; *G*, *H*, *I*, fifth segment, No. 1899–1; *J*, *K*, *L*, sixth segment, No. 1900–1. Rancho La Brea Pleistocene.

Fig. 21.—*Nothrotherium shastense* Sinclair. Left scaphoid, No. 1944–L–1. *A*, distal view; *B*, dorsal view; *C*, proximal view. × 0.50. Rancho La Brea Pleistocene.
Hapalops sp. Left scaphoid, No. 15171 P. U. C. A^1, B^1, C^1, same views as in *A*, *B*, *C*. × 1.0. Santa Cruz Miocene.

Fig. 22. *Nothrotherium shastense* Sinclair. Right trapezium and metacarpal I, Nos. 1912–R–1, 1913–R–1. *A*, dorsal view; *B*, proximal end; *C*, distal end; *D*, inner view. × 0.50. Rancho La Brea Pleistocene.

Fig. 23.—*Nothrotherium shastense* Sinclair. Left metacarpal II, No. 1914–L–1. *A*, inner view; *B*, dorsal view; *C*, outer view; *D*, proximal end; *E*, distal end. × 0.50. Rancho La Brea Pleistocene.
Hapalops sp. Left metacarpal II, No. 15171 P. U. C.; same views as in *A*, *B*, *C*, *D*, *E*. × 1.0. Santa Cruz Miocene.

Fig. 24.—*Nothrotherium shastense* Sinclair. Second phalangeal elements of manus; proximal, lateral, and distal views. × 0.50. *a*, No. 1930–L–1, digit II; *b*, No. 1929–L–1, digit III; *c*, No. 1928–L–1, digit IV. Rancho La Brea Pleistocene.

FIG. 25.—*Nothrotherium shastense* Sinclair. Ungual phalanges of manus, lateral views with cross-sections through claw-processes. × 0.50. *a*, digit II; *b*, digit III; *c*, digit IV. Rancho La Brea Pleistocene.

FIG. 26.—*Nothrotherium shastense* Sinclair. Right metacarpal V, No. 1917–R–1. *A*, dorsal view; *B*, inner view; *C*, outer view. × 0.50. Rancho La Brea Pleistocene.
Hapalops sp. Left metacarpal V, No. 15171 P. U. C. A^1, dorsal view; B^1, inner view. × 1.0. Santa Cruz Miocene.

FIG. 27.—*Megalonyx*, probably *wheatleyi* Cope. Right manus, Amer. Mus. Spec., dorsal view. × 0.50. Port Kennedy fissure, Pennsylvania, Pleistocene.

FIG. 28.—*Nothrotherium maquinense* (Lund). Right manus, dorsal view, after Winge; approx. × 0.66. Brazil, Pleistocene.

FIG. 29.—*Nothrotherium shastense* Sinclair. Right posterior limb. *A*, lateral view; *B*, anterior view. × 0.166. Rancho La Brea Pleistocene.

FIG. 30.—*Nothrotherium shastense* Sinclair. Right calcaneum, No. 1877–R–1. *A*, inner view; *B*, view of articulating end; *C*, dorsal view. × 0.50. Rancho La Brea Pleistocene.
Hapalops elongatus Ameghino. Right calcaneum, No. 15155, P. U. C. A^1, B^1, C^1, same views as in *A*, *B*, *C*. × 1.0. Santa Cruz Miocene.

FIG. 31.—*Nothrotherium shastense* Sinclair. Right astragalus, No. 1875–R–1. *A*, tibial view; *B*, inner view; *C*, calcaneal view; *D*, lateral view. × 0.50. Rancho La Brea Pleistocene.
Megalonyx, probably *wheatleyi* Cope. Right astragalus, Amer. Mus. Spec. A^1, B^1, C^1, D^1, same views as in *A*, *B*, *C*, *D*. × 0.50. Port Kennedy fissure, Pennsylvania, Pleistocene.
Hapalops sp. Right astragalus, No. 15594, P. U. C. A^2, B^2, C^2, D^2, same views as in *A*, *B*, *C*, *D*. × 1.0. Santa Cruz Miocene.

FIG. 32.—*Nothrotherium shastense* Sinclair. Right cuboid, No. 1885–R–1. *A*, distal view; *B*, dorsal view; *C*, proximal view. × 0.50. Rancho La Brea Pleistocene.
Hapalops indifferens Ameghino. Right cuboid, No. 15110, P. U. C. A^1, B^1, C^1, same views as in *A*, *B*, *C*. × 1.0 Santa Cruz Miocene.

FIG. 33.—*Nothrotherium shastense* Sinclair. Right navicular, No. 1891–R–1. *A*, distal view; *B*, view of cuboid face; *C*, view of astragalar face. × 0.50. Rancho La Brea Pleistocene.
Hapalops elongatus Ameghino. Right navicular, No. 15545, P. U. C. A^1, B^1, C^1, same views as in *A*, *B*, *C*. × 1.0. Santa Cruz Miocene.

FIG. 34.—*Nothrotherium shastense* Sinclair. Left ectocuneiform, No. 1943–L–2. *A*, navicular view; *B*, metatarsal view. × 0.50. Rancho La Brea Pleistocene.
Hapalops elongatus Ameghino. Right ectocuneiform, No. 15160 P. U. C. A^1, B^1, same views as in *A*, *B*. × 1.0. Santa Cruz Miocene.

FIG. 35.—*Nothrotherium shastense* Sinclair. Right entocuneiform and metatarsal I, No. 1880–R–2. *A*, ventral view; *B*, external view; *C*, dorsal view; *D*, proximal view showing these elements in articulation with mesocuneiform and metatarsal II. × 0.50. Rancho La Brea Pleistocene.

FIG. 36.—*Nothrotherium shastense* Sinclair. Right mesocuneiform and metatarsal II, No. 1881–R–2. *A*, outer view; *B*, dorsal view; *C*, inner view; *D*, proximal end; *E*, distal end; *F*, proximal end of metatarsal II, No. 1881–R–1. × 0.50. Rancho La Brea Pleistocene.
Hapalops elongatus Ameghino. Right metatarsal II, No. 15545 P. U. C. A^1, B^1, C^1, D^1, E^1, same views as in *A*, *B*, *C*, *D*, *E*. × 1.0. Santa Cruz Miocene.

FIG. 37.—*Nothrotherium shastense* Sinclair. Right phalanx I, digit II, pes, No. 1886–R–1. *A*, proximal view; *B*, lateral view; *C*, distal view. × 0.50.

FIG. 38.—*Nothrotherium shastense* Sinclair. Phalanx II, digit II, pes. No. 1887–R–1; proximal, lateral, and distal views. × 0.50. Rancho La Brea Pleistocene.

FIG. 39.—*Nothrotherium shastense* Sinclair. Right metatarsal III, No. 1882–R–1. *A*, distal view; *B*, inner view; *C*, outer view; *D*, proximal view. × 0.50. Rancho La Brea Pleistocene.
Hapalops elongatus Ameghino. Right metatarsal III, No. 15545 P. U. C. A^1, B^1, C^1, D^1, same views as in *A*, *B*, *C*, *D*. × 1.0. Santa Cruz Miocene.

FIG. 40.—*Nothrotherium shastense* Sinclair. Co-ossified phalanges I and II, digit III, pes. *A*, *B*, *C*, No. 1889–L–2 with inner sesamoid bone, proximal, lateral, and distal views. × 0.50. *D*, No. 1889–L–1, dorsal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 41.—*Nothrotherium shastense* Sinclair. Ungual phalanges, right pes. Lateral view. × 0.50. *a*, digit III, No. 1890–R–1; *b*, digit II, No. 1888–R–1. Rancho La Brea Pleistocene.

FIG. 42.—*Nothrotherium shastense* Sinclair. Right metatarsal IV, No. 1883–R–1. *A*, outer view; *B*, dorsal view; *C*, inner view; *D*, proximal end; *E*, distal end. × 0.50. Rancho La Brea Pleistocene.
Hapalops elongatus Ameghino. Right metatarsal IV, No. 15545 P. U. C. A^1, B^1, C^1, D^1, E^1, same views as in *A*, *B*, *C*, *D*, *E*. × 1.0. Santa Cruz Miocene.

FIG. 43.—*Nothrotherium shastense* Sinclair. Right metatarsal V, No. 1884–R–1. *A*, dorsal view; *B*, inner view; *C*, ventral view. × 0.50. Rancho La Brea Pleistocene.
Hapalops elongatus Ameghino. Right metatarsal V, No. 15545 P. U. C. A^1, B^1, C^1, same views as in *A*, *B*, *C*. × 1.0. Santa Cruz Miocene.

FIG. 44.—*Megalonyx*, sp. *A* and *B*, fifth superior tooth, No. 6000–1. × 1.0. Rancho La Brea Pleistocene.

FIG. 45.—*Megalonyx jeffersonii californicus* Stock. Right unciform, No. 22775 U. C. C. *A*, proximal view; *B*, dorsal view; *C*, ventral view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 46.—*Megalonyx jeffersonii californicus* Stock. Patella, No. 22776 U. C. C. *A*, anterior view; *B*, femoral view. × 0.50. Rancho La Brea Pleistocene.

FIG. 47.—*Megalonyx jeffersonii californicus* Stock. Left calcaneum, No. 20095, U. C. C. *A*, outer view; *B*, view of articulating end; *C*, inner view. × 0.33. Rancho La Brea Pleistocene.

FIG. 48.—*Megalonyx jeffersonii californicus* Stock. Right metatarsal III, No. 20001 U. C. C. *A*, proximal view; *B*, outer view; *C*, inner view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 49.—*Megalonyx jeffersonii californicus* Stock. Right metatarsal IV, No. 6002–1. *A*, inner view; *B*, dorsal view; *C*, outer view; *D*, proximal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 50.—*Megalonyx jeffersonii californicus* Stock. Right metatarsal V, No. 22773 U. C. C. *A*, dorsal view; *B*, inner view × 0.50. Rancho La Brea Pleistocene.

FIG. 51.—Map showing occurrences of Pleistocene Megalonychinae in western North America. 1, Rancho La Brea; 2, Alameda County; 3, Hawver Cave, Eldorado County; 4, Potter Creek Cave and Samwel Cave, Shasta County; 5, Bautista Creek Badlands, Riverside County; 6, White Bluffs near Hanford, south central Washington; 7, Murphys, Calaveras County; 8, Douglas City, Trinity County; 9, San Pedro, Los Angeles County.

FIG. 52.—*Megalonyx* sp. Skull fragment with superior cheek-teeth of right side. × 1.0. White Bluffs, near Hanford, Washington.

FIG. 53.—*Nothrotherium shastense* Sinclair. Right metacarpal IV, No. 9443 U. C. C. *A*, inner view; *B*, dorsal view; *C*, outer view; *D*, proximal end; *E*, distal end. × 0.50. Samwel Cave Pleistocene, California.
Hapalops sp. Left metacarpal IV, No. 15171 P. U. C. A^1, B^1, C^1, D^1, E^1, same views as in *A*, *B*, *C*, *D*, *E*. × 1.0. Santa Cruz Miocene.

FIG. 54.—*Nothrotherium shastense hawveri* Stock. Left unciform, No. 22899 U. C. C. *A*, proximal view; *B*, dorsal view; *C*, ventral view; *D*, distal view. × 0.50. Hawver Cave Pleistocene, California.

FIG. 55.—*Mylodon harlani* Owen. Section through middle of a dermal ossicle showing entrance of a vascular canal and inner honeycombed cavity. × 2.0.

FIG. 56.—*Mylodon harlani* Owen. Skull, dorsal view. × 0.33. *n*, nasal; *mx*, maxillary; *l*, lachrymal; *fr*, frontal; *sq*, squamosal; *pa*, parietal; *so*, supraoccipital. Rancho La Brea Pleistocene.

FIG. 57.—*Mylodon harlani* Owen. Skull, ventral view. × 0.33. *mx*, maxillary; *pl*, palatine; *pt*, pterygoid; *sq*, squamosal; *per*, periotic; *bo*, basioccipital; *bs*, basisphenoid; *flm*, foramen lacerum medium; *flp*, foramen lacerum posterius; *fc*, condylar foramen; 2, second superior tooth; 5, fifth superior tooth. Rancho La Brea Pleistocene.

FIG. 58.—*Mylodon harlani* Owen. Skull, lateral view. × 0.33. *os*, orbitosphenoid; *as*, alisphenoid; *eo*, exoccipital; *lf*, lachrymal foramen; *fla*, *fo*, combined optic foramen and foramen lacerum anterius; *fro*, combined foramen rotundum and foramen ovale; remaining letters as in other figures. Rancho La Brea Pleistocene.

FIG. 59.—*Mylodon harlani* Owen. Skull, posterior view. × 0.33. Letters as in other figures. Rancho La Brea Pleistocene.

FIG. 60.—*Mylodon harlani* Owen. Vertical longitudinal section of skull, No. 1717–2. × 0.33. *mxt*, maxillo-turbinal; *et* ethmo-turbinals; *s*, sinus in frontal, parietal, and basisphenoid; *O?* V^1, canal for first branch of trigeminal nerve and possibly the optic nerve; V^2, V^3, canal for second and third branches of the trigeminal nerve: *IX*, *X*, *XI*, exit for ninth, tenth, eleventh cranial nerves; *XII*, exit for twelfth nerve; remaining letters as in other figures, Rancho La Brea Pleistocene.

FIG. 61.—*Mylodon harlani* Owen. Skull fragment with right superior teeth of young individual, No. 1717–35; inferior and lateral views. × 0.50. Note small size of first superior tooth. Rancho La Brea Pleistocene.

FIG. 62.—*Mylodon harlani* Owen. Occlusal views of second superior tooth, showing variation in shape of crowns. × 0.50. Rancho La Brea Pleistocene.

FIG. 63.—*Mylodon harlani* Owen. Occlusal views of left fourth superior tooth, showing variation in shape of crowns. × 0.50. Rancho La Brea Pleistocene.

FIG. 64.—*Mylodon harlani* Owen. Occlusal views of right fifth superior tooth showing variation in shape of crowns. × 0.50. Rancho La Brea Pleistocene.

FIG. 65.—*Mylodon harlani* Owen. Occlusal views of left third inferior tooth showing variation in shape of crowns. × 0.50. Rancho La Brea Pleistocene.

FIG. 66.—*Mylodon harlani* Owen. Occlusal views of right fourth inferior tooth, showing variation in shape of crowns. × 0.50. Rancho La Brea Pleistocene.

FIG. 67.—*Mylodon harlani* Owen. Cervical vertebra VII, No. 1573–6 with cervical rib, No. 1737–1; anterior view. × 0.33. *cr*, cervical rib; *ccr*, facet for capitulum of cervical rib; *fcr*, facet for tuberculum of cervical rib; *vac*, vertebrarterial canal; *tp*, transverse process; *az*, anterior zygapophysis. Rancho La Brea Pleistocene.

FIG. 68.—*Mylodon harlani* Owen. Thoracic vertebra XV, No. 1588–4, anterior and posterior views of right half. × 0.33.; az^1, lateral anterior zygapophysis; az^2, medial anterior zygapophysis; pz^1, lateral posterior zygapophysis; pz^2, medial posterior zygapophysis; *m*, metapophysis; *tp*, transverse process; *cr*, facet for capitulum of rib; *fr*, facet for tuberculum of rib. Rancho La Brea Pleistocene.

FIG. 69.—*Mylodon harlani* Owen. *A*, *B*, and *C*, views of falciform bone of manus, No. 1700–19. × 0.50. Rancho La Brea Pleistocene.

FIG. 70.—*Mylodon harlani* Owen. Right scaphoid, No. 24261 U. C. C. *A*, distal surface with facet for trapezoid at right and facet for magnum at left; *B*, proximal surface with articulation for radius; *C*, dorsal view with facet for trapezium at right; *D*, dorso-external view. × 0.50. Rancho La Brea Pleistocene.

FIG. 71.—*Mylodon harlani* Owen. Right lunar, No. 24262 U. C. C. *A*, proximal view of articulating surface for radius; *B*, distal view with surface for unciform in middle, a small portion of facet for magnum shown on left and facet for cuneiform on right; *C*, dorsal view; *D*, inner view with surface for scaphoid above and that for magnum below; *E*, outer view. × 0.50. Rancho La Brea Pleistocene.

FIG. 72.—*Mylodon harlani* Owen. Right cuneiform, No. 24263 U. C. C. *A*, proximal view of ulnar surface; *B*, dorsal view; *C*, distal view of surface for unciform; *D*, palmar view showing facet for pisiform; *E*, inner view with facet for lunar. × 0.50. Rancho La Brea Pleistocene.

FIG. 73.—*Mylodon harlani* Owen. Right pisiform, No. 24264 U. C. C. *A*, outer distal view; *B*, view of surface for cuneiform; *C*, proximo-internal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 74.—*Mylodon harlani* Owen. Right unciform, No. 24265 U. C. C. *A*, dorsal view; *B*, inner view; *C*, outer view showing surface for cuneiform; *D*, proximal view; *E*, distal view showing surfaces for metacarpals IV and V. × 0.50. Rancho La Brea Pleistocene.

FIG. 75.—*Mylodon harlani* Owen. Right magnum, No. 24266 U. C. C. *A*, proximal view; *B*, distal view; *C*, dorsal view; *D*, inner view; *E*, outer view. × 0.50. Rancho La Brea Pleistocene.

FIG. 76.—*Mylodon harlani* Owen. Right trapezoid, No. 24267 U. C. C. *A*, proximal view; *B*, inner view showing below the facet for metacarpal II; *C*, dorsal view; *D*, outer view showing above deflected surface for scaphoid and below facet for magnum; *E*, distal view showing from left to right the facets for magnum, metacarpal III, metacarpal II. × 0.50. Rancho La Brea Pleistocene.

FIG. 77.—*Mylodon harlani* Owen. *A* to *D*, right metacarpal I and trapezium, No. 24268 U. C. C. *A*, dorsal view; *B*, proximal view; *C*, outer view showing on left a small facet for metacarpal II; *D*, distal view showing on right surface for digit I and on left the distal portion of facet for metacarpal II. × 0.50. *E*, left metacarpal I, No. 1482–L–21, dorsal view; *F*, trapezial moiety, dorsal view; *G*, trapezial moiety showing contact surface for metacarpal II; *H*, metacarpal I, No. 1482–R–11, dorsal view; *I*, No. 1482–R–11, inner view showing facet for trapezial moiety. × 0.50. Rancho La Brea Pleistocene.

FIG. 78.—*Mylodon harlani* Owen. Co-ossified phalanges I and II, digit I, right manus, No. 24269 U. C. C. *A*, proximal view; *B*, outer view; *C*, dorsal view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 79.—*Mylodon harlani* Owen. Ungual phalanx, digit I, right manus, No. 1471–R–1. *A*, dorsal view; *B*, outer view; *C*, ventral view. × 0.50. Rancho La Brea Pleistocene.

FIG. 80.—*Mylodon harlani* Owen. Right metacarpal II, No. 24270 U. C. C. *A*, outer view; *B*, dorsal view; *C*, inner view; *D*, proximal view; *E*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 81.—*Mylodon harlani* Owen. Phalanx I, digit II, right manus, No. 24271 U. C. C. *A*, proximal view; *B*, inner view; *C*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 82.—*Mylodon harlani* Owen. Phalanx II, digit II, right manus, No. 24272 U. C. C. *A*, outer view; *B*, distal view; *C*, proximal view; *D*, dorsal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 83.—*Mylodon harlani* Owen. Ungual phalanx, digit II, right manus, No. 24273 U. C. C. *A*, outer view with cross-section of claw-process; *B*, dorsal view; *C*, ventral view. × 0.50. Rancho La Brea Pleistocene.

FIG. 84.—*Mylodon harlani* Owen. Right metacarpal III, No. 24274 U. C. C. *A*, outer view; *B*, dorsal view; *C*, inner view; *D*, proximal view; *E*, distal view; *F*, proximal view of another specimen, No. 23148 U. C. C., showing confluence of facets. × 0.50. Rancho La Brea Pleistocene.

FIG. 85.—*Mylodon harlani* Owen. Phalanx I, digit III, right manus, No. 24275 U. C. C. *A*, proximal view; *B*, outer view; *C*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 86.—*Mylodon harlani* Owen. Phalanx II, digit III, right manus, No. 24276 U. C. C. *A*, proximal view; *B*, dorsal view; *C*, outer view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 87.—*Mylodon harlani* Owen. Ungual phalanx, digit III, right manus, No. 24277 U. C. C. *A*, outer view with cross-section of claw-process; *B*, dorsal view; *C*, ventral view. × 0.50. Rancho La Brea Pleistocene.

FIG. 88.—*Mylodon harlani* Owen. Right metacarpal IV, No. 24278 U. C. C. *A*, inner view; *B*, dorsal view; *C*, outer view; *D*, proximal view; *E*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 89.—*Mylodon harlani* Owen. *A*, *B*, and *C*, outer sesamoid, metacarpal IV, left manus, No. 1462–L–4. × 1.0. Rancho La Brea Pleistocene.

FIG. 90.—*Mylodon harlani* Owen. *A*, *B*, and *C*, inner sesamoid, metacarpal IV, left manus, No. 1468–L–5 × 1.0. Rancho La Brea Pleistocene.

FIG. 91.—*Mylodon harlani* Owen. Phalanx I, digit IV, right manus, No. 24279 U. C. C. *A*, proximal view; *B*, outer view; *C*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 92.—*Mylodon harlani* Owen. Terminal phalanx, digit IV, right manus, No. 1484–R–2. *A*, proximal view; *B*, lateral view; *C*, dorsal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 93.—*Mylodon harlani* Owen. Right metacarpal V, No. 24280 U. C. C. *A*, outer view; *B*, dorsal view; *C*, distal view; *D*, inner view; *E*, ventral view. × 0.50. Rancho La Brea Pleistocene.

FIG. 94.—*Mylodon harlani* Owen. *A* to *D*, phalanx I, digit V, right manus, No. 24281 U. C. C. *E* and *F*, phalanx I, fused with rudimentary phalanx II, No. 1485–R–5. *A*, proximal view; *B*, outer view; *C*, inner view; *D*, distal view; *E*, proximal view; *F*, outer view. × 0.50. Rancho La Brea Pleistocene.

FIG. 95.—*Mylodon harlani* Owen. *A* and *B*, falciform bone of pes, No. 1701. × 0.50. Rancho La Brea Pleistocene.

FIG. 96.—*Mylodon harlani* Owen. Left calcaneum, No. 24282 U. C. C. *A*, ventral view; *B*, outer view; *C*, dorsal view; *D*, view of articular end. × 0.33. Rancho La Brea Pleistocene.

FIG. 97.—*Mylodon harlani* Owen. Left astragalus, No. 23133 U. C. C. *A*, tibial view; *B*, lateral view; *C*, calcaneal view; *D*, distal view. × 0.33. Rancho La Brea Pleistocene.

FIG. 98.—*Mylodon harlani* Owen. Left cuboid, No. 23134 U. C. C. *A*, proximal view; *B*, dorsal view; *C*, distal view; *D*, outer or calcaneal view; *E*, inner view. × 0.50. Rancho La Brea Pleistocene.

FIG. 99.—*Mylodon harlani* Owen. Left navicular, No. 23135 U. C. C. *A*, astragalar or proximal view; *B*, lateral view showing astragalar and cuboidal surfaces; *C*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 100.—*Mylodon harlani* Owen. Left ectocuneiform, No. 23136 U. C. C. *A*, proximal view; *B*, inner view; *C*, distal view; *D*, dorsal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 101.—*Mylodon harlani* Owen. Left mesocuneiform, No. 23137 U. C. C. *A*, outer view showing at right facet for ectocuneiform; *B*, proximal view; *C*, inner view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 102.—*Mylodon harlani* Owen. Left metatarsal II, No. 23138 U. C. C. *A*, proximal view; *B*, outer view; *C*, inner view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 103.—*Mylodon harlani* Owen. *A* and *B*, inner and dorsal views, right mesocuneiform and metatarsal II, No. 22771 U. C. C. *C* and *D*, dorsal and inner views of co-ossified mesocuneiform and metatarsal II, No. 22772. × 0.50. Rancho La Brea Pleistocene.

FIG. 104.—*Mylodon harlani* Owen. Co-ossified phalanges I and II, digit II, left pes, No. 23139 U. C. C. *A*, proximal view; *B*, inner view; *C*, distal view; *D*, dorsal view; *E*, ventral view. × 0.50. Rancho La Brea Pleistocene.

FIG. 105.—*Mylodon harlani* Owen. Ungual phalanx, digit II, left pes, No. 23140 U. C. C. *A*, dorsal view; *B*, ventral view; *C*, inner view with cross-section of claw-process. × 0.50. Rancho La Brea Pleistocene.

FIG. 106.—*Mylodon harlani* Owen. Left metatarsal III, No. 23141 U. C. C. *A*, dorsal view; *B*, outer view with large articulating surface for metatarsal IV; *C*, inner view with large surface for ectocuneiform; *D*, proximal view with large surface on right for ectocuneiform and small surface of articulation on left for cuboid. × 0.50. Rancho La Brea Pleistocene.

FIG. 107.—*Mylodon harlani* Owen. Phalanx I, digit III, left pes, No. 22769 U. C. C. *A*, proximal view; *B*, inner view; *C*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 108.—*Mylodon harlani* Owen. Phalanx II, digit III, left pes. *A* to *D*, No. 22769 U. C. C.; *E* to *H*, No. 23147 U. C. C. *A* and *E*, proximal views; *B* and *F*, dorsal views; *C* and *G*, inner views; *D* and *H*, distal views. × 0.50. Rancho La Brea, Pleistocene.

FIG. 109.—*Mylodon harlani* Owen. Ungual phalanx, digit III, left pes, No. 23142 U. C. C. *A*, dorsal view; *B*, ventral view; *C*, inner view with cross-section of claw-process. × 0.50. Rancho La Brea Pleistocene.

FIG. 110.—*Mylodon harlani* Owen. Left metatarsal IV, No. 23143, U. C. C. *A*, inner view; *B*, dorsal view; *C*, outer view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 111.—*Mylodon harlani* Owen. *A*, *B*, and *C*, outer sesamoid bone, digit IV, left pes, No. 1493–L–1. × 1.0. Rancho La Brea Pleistocene.

FIG. 112.—*Mylodon harlani* Owen. *A* and *B*, inner sesamoid bone, digit IV, pes No. 1444–L–1. × 1.0. Rancho La Brea Pleistocene.

FIG. 113.—*Mylodon harlani* Owen. Phalanx I with outer sesamoid, digit IV, left pes, No. 1453–L–15. *A*, proximal view; *B*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 114.—*Mylodon harlani* Owen. Phalanx I, digit IV, left pes, No. 23144 U. C. C. *A*, proximal view; *B*, outer view; *C*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 115.—*Mylodon harlani* Owen. Rudiment representing phalanges II and III, digit IV, left pes, No. 1450–L–2. *A* proximal view; *B*, inner view; *C*, dorsal view, × 0.50. Rancho La Brea Pleistocene.

FIG. 116.—*Mylodon harlani* Owen. Left metatarsal V, No. 23145 U. C. C. *A*, dorsal view; *B*, inner view; *C*, ventral view × 0.50. Rancho La Brea Pleistocene.

FIG. 117.—*Mylodon harlani* Owen. *A* to *D*, proximal phalanx, digit V, left pes, No. 23146 U. C. C.; *E*, co-ossified proximal and terminal rudiments, digit V, left pes, No. 1458–L–3. *A*, proximal view; *B* and *E*, outer views; *C*, inner view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

FIG. 118.—Map showing occurrences of Pleistocene Mylodontidae in western North America. 1, Rancho La Brea; 2, McKittrick, Kern County; 3, San Francisco peninsula; 4, Petaluma, Sonoma County; 5, Contra Costa County; 6, Marysville, Yuba County; 7, Hawver Cave, Eldorado County; 8, Carson City, Nevada; 9, Fossil Lake region, Oregon, 10, Dayton, Oregon; 11, Willamette Valley, Oregon; 12, Washtuckna Lake, Washington; 13, Klamath River; 14, Point Conception, California.

FIG. 119.—*Mylodon* near *harlani* Owen. Left ramus of mandible, No. 3859 U. S. Nat. Mus. × 0.33. fm^1, fm^2, mental foramina; 1, 2, 3, 4, inferior alveoli and teeth. Button Ranch, near Christmas Lake, Oregon.

FIG. 120.—*Mylodon* near *harlani* Owen. Incomplete left manus, No. 3859 U. S. Nat. Mus.; dorsal view. × 0.33. Button Ranch, near Christmas Lake, Oregon.

CENOZOIC GRAVIGRADE EDENTATES OF WESTERN NORTH AMERICA,

WITH SPECIAL REFERENCE TO

THE PLEISTOCENE MEGALONYCHINAE AND MYLODONTIDAE OF RANCHO LA BREA.

BY

CHESTER STOCK.

INTRODUCTION.

A study of the gravigrade edentates from the Pleistocene asphalt deposits of Rancho La Brea, near Los Angeles, California, was suggested to the writer, then a student at the University of California, by Professor John C. Merriam. The investigation, based originally on materials collected by the Department of Palaeontology, University of California, was gradually enlarged to bring also under consideration the vast collection of edentate remains in the Los Angeles Museum of History, Science, and Art. The extensive series of specimens in the Los Angeles Museum, the accessibility of the material for a detailed review, and the adequate facilities for preparation of mounted individuals made it especially desirable to direct attention to the Los Angeles collections.

While emphasis has been placed very largely on the collections in the Los Angeles Museum of History, Science, and Art, an attempt has been made to review the edentate assemblage from Rancho La Brea, as it is also represented in the Museum of Paleontology, University of California. Fortunately, the University collection supplements those in southern California, particularly in offering further specimens of the genus *Megalonyx*. As a result of the studies that have been pursued, several preliminary papers, concerned for the most part with special topics, have appeared between 1913 and 1920.

The large amount of material available from Rancho La Brea affords an admirable basis for examination of ground-sloth remains occurring not only in other Pleistocene deposits of Western North America, but in Tertiary beds as well, and the present contribution endeavors to survey this portion of the field and its bearing on the history of the gravigrade edentates.

The study of extinct North American edentates may perhaps be regarded as having inaugurated palaeontologic research on this continent, for in 1797, in a paper read before the American Philosophical Society, Thomas Jefferson described some bones from a limestone cavern in western Virginia, as belonging to an animal which he called *Megalonyx*. Since the pioneer investigations of Jefferson, published in 1799, our fund of knowledge of these mammals has been greatly augmented. The association of Jefferson's name with a species of ground-sloth now widely recognized in Pleistocene faunas and distinguished by possessing an extensive geographic range on the North American continent, reaching from the Atlantic to the Pacific Coast, is a humble but fitting tribute expressed by paleontology to one of America's greatest statesmen and scholars.

In broader palaeontological studies involving faunas of the two continents of the western hemisphere, the order Edentata has long been recognized as one which occupies an important position and comprises a number of unusual types. In the New World the edentates have undergone the major course of their evolution during Tertiary time in South America, but are also intimately connected with the Cenozoic history of North America. Highly characteristic members of this group are living to-day in the Neotropical region. It is, however, during the

Pleistocene that the edentates were well represented in the northern continent, principally by the pilosic division of the Xenarthra, including those forms known commonly as ground-sloths. The glyptodonts and the armadillos were relatively less important as members in the Pleistocene fauna of North America, judging from the infrequent record of their occurrence and their limited distribution, but it is an interesting fact that the armadillos are now the only forms that have survived in this region.

The great group of sloths, of which the living tree-sloths of the forested regions of Central and South America are but the diminutive representatives, include during the Pleistocene an array of forms. Structurally, the ground-sloths will always remain among the most unique mammals that were evolved in the Tertiary and Pleistocene of the western hemisphere. Especially to the student of mammalian evolution, as staged during the later Cenozoic in North America, will the structural characters possessed by these forms appear in many instances anomalous, pointing unmistakably to an earlier racial history in which biotic associations and physical conditions were decidedly different from those encountered by the indigenous land mammals of North America.

Within the group of ground-sloths represented in the American Pleistocene, there are recognized three divisions, commonly regarded as of family rank. These are (1) Megatheriidae, (2) Megalonychidae, and (3) Mylodontidae. In North America the family Megatheriidae, of which the gigantic ground-sloth *Megatherium* is typical, seems to be confined to the Pleistocene of the southeastern United States. This genus is apparently absent in Pleistocene deposits of western North America, and we are not particularly concerned with it in the present memoir. In western deposits *Nothrotherium* and *Megalonyx* are the representatives of the megalonychid ground-sloths, while *Mylodon* is the only known genus belonging to the Mylodontidae.

ACKNOWLEDGMENTS.

My foremost acknowledgment and very grateful appreciation go to Professor John C. Merriam. Whatever value may be ascribed to the present research rests largely on his unstinted, ever friendly advice and his assistance given on many occasions.

For the unexcelled opportunity to enlarge the observations on the edentate remains from the asphalt beds by a study of the material in the Los Angeles Museum of History, Science, and Art, and for the privilege to incorporate the results thus obtained with those derived from an examination of the university collection, I should like to express my deep obligation and sincere thanks in memory of the late director of the museum, Dr. Frank S. Daggett. The keen interest shown by Dr. Daggett in the progress of the research and the personal services rendered so generously by him have done much in promoting the best results. Acting Director Howard Robertson and the present director, Dr. Wm. Alanson Bryan, have continued the enthusiastic support given by Dr. Daggett. For the liberality shown in the furtherance of the work on the Rancho La Brea collections I wish to thank also the officials of the county of Los Angeles. I desire also to acknowledge my

great indebtedness to the University of California and to the Carnegie Institution of Washington for support given in the study of the Los Angeles collections.

Other members of the museum staff in Los Angeles have rendered meritorious service in the progress of the research. The assistance given by Mr. James W. Lytle, assistant vertebrate palaeontologist, has been especially valuable, furnishing important results. To Mr. Lytle has fallen the task of assembling the osteological materials for the mounted skeletons, a task which he has accomplished with much proficiency. Mr. Lytle has also faithfully constructed the mounted specimens of *Nothrotherium* and *Mylodon* under my direction. Mr. L. E. Wyman furnished valuable information regarding the occurrence of ground-sloth remains at Rancho La Brea and a number of photographs. The restorations of *Nothrotherium* and *Mylodon* are by Mr. Charles R. Knight.

Most of plates and a number of the line drawings used as text-figures were executed by Mr. John L. Ridgway, of the Carnegie Institution of Washington. Many of the text-figures are the work of Mrs. Louise Nash and of Miss Frieda Lueddemann.

In the course of the research on the edentates I have had opportunity to visit a number of institutions in the East and to study collections. For many favors bestowed during this visit I wish to extend my thanks particularly to Professor Henry Fairfield Osborn, to Dr. W. D. Matthew, and to Mr. Walter Granger, of the American Museum of Natural History; to Mr. C. W. Gilmore and Mr. J. W. Gidley, of the U. S. National Museum; to Dr. W. J. Holland and Mr. O. A. Peterson, of the Carnegie Museum; to Dr. Glover M. Allen, of the Harvard Museum of Comparative Zoology; to Professor R. S. Lull, of Yale University; and to Professor W. B. Scott and Dr. W. J. Sinclair, of Princeton University. Pleistocene ground-sloth remains were kindly loaned for study by the American Museum of Natural History and by the U. S. National Museum. Several loans of valuable specimens from the Patagonian Miocene, now in the collections of Princeton University, were generously granted by Dr. W. J. Sinclair.

Lastly, those friends of my shelf and study—the contributions of Richard Owen, Joseph Leidy, Richard Lydekker, Herman Burmeister, Florentino Ameghino, William B. Scott, Herluf Winge, and others—have laid the foundations upon which it has been possible to build.

REVIEW OF THE LITERATURE ON THE GRAVIGRADE EDENTATES.

MEGALONYCHINAE.

Following the early description of *Megalonyx* by Thomas Jefferson, further remains of this animal were discovered which led to a somewhat better understanding of the form. The specimens collected in West Virginia, Tennessee, Kentucky, Mississippi, and Alabama in the period following the publication of Jefferson's report and prior to 1855, and described or discussed by Cuvier, Owen, Harlan, Jeffries Wyman, and William Cooper, formed the basis of an excellent monograph by Joseph Leidy (1855).

While research on the North American edentates was in progress, the extinct mammalian life of South America was also subjected to searching inquiry. The vast stretches of the pampas of Argentina and the limestone caverns of Brazil offered opportunities of collecting in Pleistocene deposits comparable to those in North America. In the early part of the nineteenth century we note the investigations of the Danish naturalist P. W. Lund in the Brazilian caverns which gave the first information regarding the very important Pleistocene fauna now known from these deposits. Ground-sloth remains described by Lund (1836) from the cave deposits were at first regarded as belonging to a small megathere. Lund later recognized the distinctness of the form and established the genus *Coelodon*. This is the first indication of a megalonychid ground-sloth later recognized in Pleistocene faunas of North America. In the report on the ground-sloth remains collected by Charles Darwin during the voyage of the *Beagle*, Owen (1840, p. 99, pl. 29) described and figured a fragmentary mandible which was referred to *Megalonyx*. This specimen was reviewed by Leidy, who correctly determined it as not pertaining to the North American megalonychid genus.

In the great development of palaeontologic research in North America, witnessed by the latter half of the nineteenth century, our knowledge of the Pleistocene Megalonychinae was increased by descriptions of fragmentary materials pertaining to species of *Megalonyx* other than *M. jeffersonii* and of specimens, in part heretofore unknown, assigned to the latter form. These North American remains were described principally from localities east of the Mississippi River. Thus, Leidy (1860) published a description of additional skeletal elements giving more complete information regarding the structure of the feet in *Megalonyx*.

E. D. Cope (1871) published a preliminary report of the Pleistocene fauna from the famous Port Kennedy fissure of Pennsylvania, in which were described several species of *Megalonyx*, based chiefly upon parts of the dentition. Twenty years after the publication of Cope's paper, E. W. Claypole (1891) reported upon the occurrence of *Megalonyx* in Ohio and listed a number of skeletal structures which were referred to *M. jeffersonii*. In the following year, J. M. Safford (1892) announced the discovery of a fairly complete pelvis of *Megalonyx* and of other bones in Big Bone Cave, Tennessee. No detailed description and comparison of

the pelvis were given by Safford. This specimen is now in the collections of Vanderbilt University, Nashville, Tennessee.

The fourth annual report of the Texas Geological Survey contains a description of fragmentary skull material and a single tooth referred by Cope (1892) to the species *Megalonyx leptostomus*. The specimens are from the Blanco Upper Pliocene and occur in association with *Pliohippus simplicidens*, *P. cumminsii*, and the carnivore *Borophagus*. This is the first record of a megalonychid ground-sloth in North America from deposits older than Pleistocene. Whether the species belongs to *Megalonyx* is perhaps still a matter of conjecture.

Lindahl (1893) published the description of the species *Megalonyx leidyi* based upon a well-preserved skull without mandible from the Pleistocene of Kansas. In the final report of the Pleistocene fauna from the Port Kennedy fissure by Cope (1899), published after his death, the four species *Megalonyx wheatleyi*, *M. loxodon*, *M. tortulus*, and *M. scalper* were recognized as valid forms. *Megalonyx sphenodon* (also established in the earlier paper on the Port Kennedy fauna) was no longer considered specifically separable from *M. wheatleyi*, and *M. dissimilis* (established previously by Leidy) was regarded as synonymous with *M. jeffersonii*.

During the latter half of the nineteenth century a number of paperr appeared which treated of the systematic position, structural characters, and relationships of the South American genus *Coelodon* (*Nothrotherium*). It is, howeves, particularly from the excellent account of *Coelodon* by Reinhardt (1878), based on materials of a young individual previously collected by Lund, that we secure considerable information regarding this genus. Reinhardt clearly indicated for the first time the close agreement that exists between *Megalonyx* and *Coelodon* in many characters. In 1889, Lydekker called attention to the preoccupation of the generic name *Coelodon* and proposed to replace the name used by Lund for this ground-sloth by *Nothrotherium*.

Several years after the publication of Reinhardt's paper, Burmeister (1882) described the form *Nothropus priscus* from a fragmentary right ramus of the mandible found presumably in Pleistocene deposits along the Rio Carcaranal, in the province of Santa Fe, Argentina. The specimen was compared principally with the living tree-sloths by Burmeister. So far as comparison can be made, *Nothropus* agrees with *Nothrotherium* in shape of inferior cheek-teeth, but is less specialized in the retention of the first or foremost tooth as indicated by the presence of an alveolus. F. Ameghino considers *Nothropus priscus* as directly ancestral to *Nothrotherium* and as occurring at a lower stratigraphic horizon than the latter.

The monumental work of Scott (1903–4) on the edentates of the Upper Miocene Santa Cruz deposits of Patagonia gave, for the first time, to students of Tertiary and Pleistocene mammalogy very full information relating to these types. In the family Megalonychidae previously established generic and specific types were reviewed and new forms were described. Among the latter was the genus *Megalonychotherium*, considered to be related to *Megalonyx* in the same way that *Hapalops*, also from Santa Cruz deposits, is related to *Nothrotherium*. *Hapalops* is represented by a number of species, but the most complete material described

by Scott was grouped under *H. longiceps* and *H. elongatus*. Frequent comparisons of structure were made with the Pleistocene *Megalonyx* and *Nothrotherium*. In the present study of the ground-sloths from Rancho La Brea this contribution to the history of the American edentates by Scott has been the source of much valuable data.

It was not until the early years of the present century, when the limestone caverns of northern California were systematically explored by the Department of Palaeontology, University of California, and the Pleistocene faunas from the deposits were studied in detail, that *Nothrotherium* was tentatively recorded by Sinclair (1905) as a constituent of the North American Pleistocene fauna as well as of the South American assemblage. It was recognized in Potter Creek Cave, Shasta County, in association with remains of *Megalonyx*. In the same paper Sinclair described the species *Megalonyx sierrensis*, based upon a lower jaw and skeletal material secured from the Pleistocene of Mercer's Cave, near Murphys, Calaveras County, California. Ground-sloth remains similar to those described by Sinclair from Potter Creek Cave were collected by E. L. Furlong in Samwel Cave, Shasta County. The specimens were tentatively regarded by Furlong (1906) as belonging to *Megalonyx*. In the following year appeared a valuable paper by Florentino Ameghino (1907), in which mammalian remains were described from the limestone grotto of Iporanga in the State of São Paula, Brazil. Ameghino's report is devoted in part to the description of a damaged skull and dentition of *Nothrotherium maquinense*, and is followed by a discussion of the relationship and parentage of the genus. A bibliography on *Nothrotherium* accompanies the paper.

Nothrotherium was definitely recognized by Stock (1913) in the Rancho La Brea fauna, where it is found associated with *Megalonyx*. Since then the presence of the genus has been established in the Pleistocene fauna of Samwel Cave and in that of Hawver Cave (Stock, 1918) in Eldorado County, California, occurring always with *Megalonyx*. The presence of *Nothrotherium* in Pleistocene fissure deposits of California is therefore directly comparable to its occurrence in the Brazilian caverns. Aside from the localities in California, the genus is now known to have lived in Texas[a] during the Pleistocene, for a damaged skull of *Nothrotherium* reported to have come from "a well, at a depth of 40 feet, in Wheeler County," was described by O. P. Hay (1916).

A year previous to the appearance of Hay's paper there was published the important report by the veteran zoologist Herluf Winge (1915). In this volume Winge surveys all the edentate materials collected by Lund in the limestone caverns of Lagoa Santa, Minas Geraes, Brazil, and now in the collections of the Zoological Museum at the University of Copenhagen. Among the illustrations should be noted the first views that have been made available of the greater portions of the feet of *Nothrotherium*.

[a] In a discussion of the quicksilver deposits of the Terlingua district, Brewster County, Texas, H. W. Turner makes mention (Economic Geology, vol. 1, p. 275, 1906) of the finding of ground-sloth remains in a fissure deposit. The material was submitted to Professor J. C. Merriam, who identified several teeth as belonging to *Nothrotherium*. The specimens were placed in the Museum of the California Academy of Sciences in San Francisco, where they were destroyed by the fire of April 18, 1906.

In recent surveys of Pleistocene faunas of North America by O. P. Hay[a] an attempt is made to determine the position of *Megalonyx* in the Pleistocene with reference to the stages of advance and retreat of the continental ice-sheets during that period. The charts employed by Hay to illustrate the geographic distribution of *Megalonyx* clearly demonstrate the extensive range of this genus. With the exception of the occurrences in California, the megalonychid forms are at present rarely noted in Pleistocene deposits located in the region west of the Wasatch. Recently Merriam and Buwalda[b] reported the presence of a species of *Megalonyx* in a fauna from the White Bluffs exposed along the Columbia River in south-central Washington.

One of the very interesting and important problems in the study of the megalonychid ground-sloths arises from the discovery of remains of these forms in Pleistocene cave, fissure, and spring deposits on islands of the Greater Antilles. The presence of *Megalocnus* in the Pleistocene of Cuba was early recognized by De Castro. The genus was described by Leidy (1868), who regarded it as closely related to the North American *Megalonyx*. Anthony (1918) has described the megalonychid genus *Acratocnus* from remains found in deposits on the island of Porto Rico. Dr. W. D. Matthew (1919) has recently reviewed the discoveries of extinct mammals in the West Indies and has added three distinct megalonychid genera to the Pleistocene assemblage known from Cuba.

Wilhelm Freudenberg[c] has described from the Pleistocene of Mexico the species *Nothrotherium mexicanum*, based on a fragmentary ramus of the mandible of a young individual.

Recent descriptions of fragmentary remains of megalonychid ground-sloths from southern California by Childs Frick[d] should be cited, for they bring to view forms from two distinct Pliocene horizons. Information relating to the Tertiary forms of North America is much desired, for the types are still known only by very incomplete specimens.

MYLODONTIDAE.

The earliest descriptions of mylodont ground-sloth remains from North America are those published between 1831 and 1835 by Richard Harlan (1835) and based upon incomplete materials, including a fragmentary right ramus of the mandible. In referring them to *Megalonyx laqueatus*, Harlan failed, however, to recognize the generic characteristics of the form. The incomplete mandible described by him is regarded as having been found at Big Bone Lick, Kentucky.

The recognition of mylodont ground-sloths in the past mammalian life of America occurred later than that of *Megatherium*, for it was not until the epoch-making voyage of the *Beagle* that a sufficient collection was secured by Charles Darwin in South America to establish the group as distinct from other ground-

[a] O. P. Hay, The recognition of Pleistocene faunas, Smithson. Misc. Coll., vol. 59, No. 20, 16 pp., 1912.

[b] J. C. Merriam and J. P. Buwalda, Age of strata referred to the Ellensburg formation in the White Bluffs of the Columbia River. Univ. Calif. Publ., Bull. Dept. Geol., vol. 10, pp. 255–266, plate 13, 1917.

[c] Wilhelm Freudenberg, Geologie von Mexiko dargestellt nach der Literatur und nach eigenen Forschungen, Borntraeger, Berlin, pp. 140–141, and accompanying plate, fig. 3, 1921.

[d] Childs Frick. Extinct vertebrate faunas of the badlands of Bautista Creek and San Timoteo Cañon, Southern California. Univ. Calif. Publ., Bull. Dept. Geol., vol. 12, pp. 320–321, 349–350, 1921.

sloths. Sir Richard Owen (1840), in the report on the fossil mammalian remains collected by Darwin, described three genera. It is in this report that Owen also recognized the mylodont characters exhibited in the lower jaw described by Harlan and designated the specimen as the type of the species *Mylodon harlani*.

In 1841, the Royal College of Surgeons of London acquired a skeleton of a mylodont sloth collected in Pleistocene beds 7 leagues north of Buenos Aires. The specimen formed the basis of a profound study by Owen (1842), whose memoir on *Mylodon robustus* remains to-day a source of very complete information regarding the osteology of the genus. Owen's statement of the probable habits of *Mylodon* is a splendid example of astute deductive reasoning from materials available to a palaeontologist.

The earliest record of remains of mylodont ground-sloths in western North America is that by Perkins (1842), based on specimens found at a depth of 12 feet in the Willamette Valley, in latitude 44° north, western Oregon. The tooth and humerus described by Perkins were mentioned by Owen in a letter to the American Journal of Science, dated 1842, in which he referred the specimens to *Mylodon harlani*. The remains of *Mylodon* recovered in Benton County, Missouri, and described by Harlan (1843) under the name *Orycterotherium missouriensis*, were also considered by Owen as belonging to *Mylodon harlani*.

Leidy (1855, pp. 47–49, plate 16), in the valuable memoir on the Pleistocene sloth tribe, described and figured the type specimen of *Mylodon harlani* and reviewed several other collections of mylodont remains. In addition to the occurrences at the type locality and in Oregon and Missouri, there were noted those at Ashley River, South Carolina, Mammoth Ravine, Mississippi, and at Natchez, Mississippi.

In the period of 10 or 15 years following the publication of Leidy's memoir, little if any information regarding the North American Mylodontidae was added to the knowledge already in the possession of the palaeontologist. Leidy (1870) indicated the presence of a mylodont ground-sloth in Central America. Cope (1871), in the preliminary report on the Pleistocene vertebrates from the Port Kennedy fissure, recorded questionably the occurrence of *Mylodon*. Seven years later Cope (1878), on the basis of fragmentary specimens, established the species *Mylodon sodalis*, stating that the material came from the Pliocene of Oregon. The form is a member of the important Pleistocene assemblage known from the Fossil Lake beds of the Great Basin region. Cope (1880) also mentions the occurrence of *Mylodon* in auriferous gravels of the Klamath River, near Yreka, California. In the early eighties we note the first statement (Le Conte, 1882, 1883) regarding the "human" footprints in the Pleistocene beds near Carson City, Nevada, in which their origin is attributed to the ground-sloth. In 1889, Leidy recorded *Mylodon* in the Pleistocene of Louisiana, describing specimens from the salt mine of Petite Anse. Cope (1889) reviewed the edentates of North America and in the nineties he made shorter contributions to the Mylodontidae (Cope, 1893, 1895, 1899) from specimens collected on the Staked Plains of Texas, from Petite Anse, and from the Port Kennedy fissure. S. W. Williston (1895) also described a specimen from the Pleistocene of Kansas.

Since mylodont ground-sloths were native to South America and occur in Pleistocene beds much more frequently than in deposits of similar age in North America, it is but natural to find a greater number of papers dealing with these forms. In the latter half of the nineteenth century appeared first the description of *Scelidotherium leptocephalum* by Owen (1857). This important report is followed by Gervais's account (1860) of the skeletal structures of *Lestodon armatus*. Several years later, Gervais (1869) and Pouchet (1868–69) discussed the endocranial casts of *Mylodon* and of allied forms. In the seventies appeared two noteworthy contributions by Reinhardt (1875, 1879), in which were given the structural characters of *Lestodon armatus* and of *Grypotherium darwinii*. In the period 1864 to 1881 a number of valuable additions to our knowledge of the South American gravigrade edentates were made by Herman Burmeister. Special notice should be given to Burmeister's papers of 1879 and 1881, wherein important data are recorded on the osteology and probable habits of the mylodont ground-sloths, and a statement of the types known from South America. Lydekker (1886) reviewed the characters of *Scelidotherium leptocephalum* and described two other species of this genus. In the early eighties a number of genera and species of mylodont ground-sloths were described by Florentino Ameghino, but many of these have since been referred to previously established forms. In a later work, Ameghino (1889) gathered together information of known types and added descriptions of others. In the valuable and very useful report on the extinct edentates of Argentina, Lydekker (1894) recognizes, as valid genera in the group of mylodont ground-sloths, *Mylodon*, *Glossotherium*, *Scelidotherium*, and *Catonyx*. The fine plates published with this memoir illustrate not only the skull, but also the mounted skeletons of mylodont genera. Lydekker critically examined the basis for establishing genera and species within the group and pointed out the great amount of variation that exists in the skull and dentition. Many previously described genera and species were regarded as invalid types.

The closing years of the nineteenth century and the opening years of the twentieth witnessed the discovery and announcement of the remarkably preserved mylodont ground-sloth remains in a large cavern near Consuelo Cove, Last Hope Inlet, Patagonia. Most interesting specimens of not only skeletal structures, but of the horny claws and skin as well, were collected by the explorer Dr. Otto Nordenskjöld in 1896 and by Dr. F. P. Moreno in 1897. The ground-sloth materials from the Patagonian cave were described in detail by Lönnberg (1899), Smith Woodward (1899, 1900), and by Roth and Lehman-Nitsche (1901). Erland Nordenskiöld (1900) also described remains of the ground-sloth and of associated forms from this locality. Interesting results of studies of the skin and hair of the Patagonian ground-sloth were published by Ridewood (1901) and by Jacob (1902). The discovery of specimens showing a remarkable state of preservation and yet belonging to types characteristic of the Pleistocene of the New World aroused scientific discussion, as well as much popular interest. The presence of ground-sloths in the Recent fauna of the unexplored regions of South America was regarded as so probable that an expedition was actually sent from England to hunt these

animals. Failing in its primary purpose, the expedition furnished opportunity to make further observations on Patagonia and its inhabitants.[a]

Noteworthy remains of mylodont ground-sloths were described by Gervais (1873) and by Burmeister (1879, 1881*b*) from the valley of the Rio de la Tarija, Bolivia, and additional observations on specimens from this locality were made by Nordenskiöld (1901) and by Ameghino (1902). Philippi had directed attention to the mylodont forms occurring at Ulloma, Bolivia. Later, Sefve (1915) described skulls of *Scelidotherium* collected at Tarija and Ulloma. In the memoir by Scott (1903–4), already referred to, we find (under the discussion of the Mylodontidae from the Santa Cruz, Upper Miocene beds of Patagonia) the recognition of the two genera *Analcitherium* and *Nematherium*. The small representation of the Mylodontidae in the Santa Cruz stands in noticeable contrast to that of the Megalonychinae. Interesting comments on the family as developed at this stage of geologic time are made by Scott. Rautenburg (1906) discussed the structure of the skull and of the skeletal elements of *Pseudolestodon* (*Mylodon?*) *hexaspondylus*.

Meanwhile, our knowledge of the Mylodontidae in North America was increased much more slowly, chiefly because the occurrences were infrequent and the collections were oftentimes in a poor state of preservation. J. C. Merriam (1899, 1900) discussed the presence of ground-sloths in the Pleistocene of California. These papers were followed by Brown's description (Brown, 1903) of the skull and skeletal structures of a ground-sloth which he described as *Paramylodon nebrascensis*. The specimens were obtained in the Pleistocene of Hay Springs, Nebraska. Three years later, Merriam (1906) announced the discovery of Pleistocene mammals in the now famous Rancho La Brea asphalt beds of southern California. He indicated in this paper and in a later publication (Merriam, 1908) the occurrence of mylodont ground-sloths. Cockerell (1909) described, from the Pleistocene near Walsenburg, Colorado, a large skull of *Mylodon*. Dermal ossicles of the Rancho La Brea species were described by W. J. Sinclair (1910). W. Freudenberg,[b] in 1910, figured a tibia from Mexico and listed the genus represented by this element as *Orycterotherium*. Important information on the North American Mylodontidae is furnished by Allen's memoir (G. M. Allen, 1913), based on collections made in 1880 by Samuel Garman in the Pleistocene deposits of the Niobrara River, Nebraska. This type was regarded by Allen as distinct from known North American forms and was described as *Mylodon garmani*.

The important Pleistocene mammalian assemblage known from Rock Creek, Briscoe County, Texas, includes also *Mylodon harlani*, remains of which were described by Lull (1915). In the year previous to the publication of Lull's paper, Stock (1914) reported on the skull and dentition of the mylodont sloths of Rancho La Brea, and other papers appeared at a later date (Stock, 1917*b*, 1917*c*, 1920).

Within recent years one of the important references to the mylodont ground-sloths of South America is that by Rovereto (1914), who indicated the types

[a] H. H. Prichard. Through the heart of Patagonia. D. Appleton & Co., N. Y., 346 pp., 1902.

[b] W. Freudenberg, Die säugetierfauna des Pliocäns und Postpliocäns von Mexiko. I. Carnivoren. Goel. u. Palae Abhandl., vol. 13, pl. 20, 1910.

occurring in later Tertiary horizons of the southern continent. In the comprehensive account of the edentates from the Pleistocene cave deposits of Brazil, Winge (1915) discusses the skull and parts of the skeleton of *Mylodon*, *Catonyx*, and *Scelidotherium*. Recent important papers by Kraglievich (1921, 1922) deal with the South American Mylodontidae.

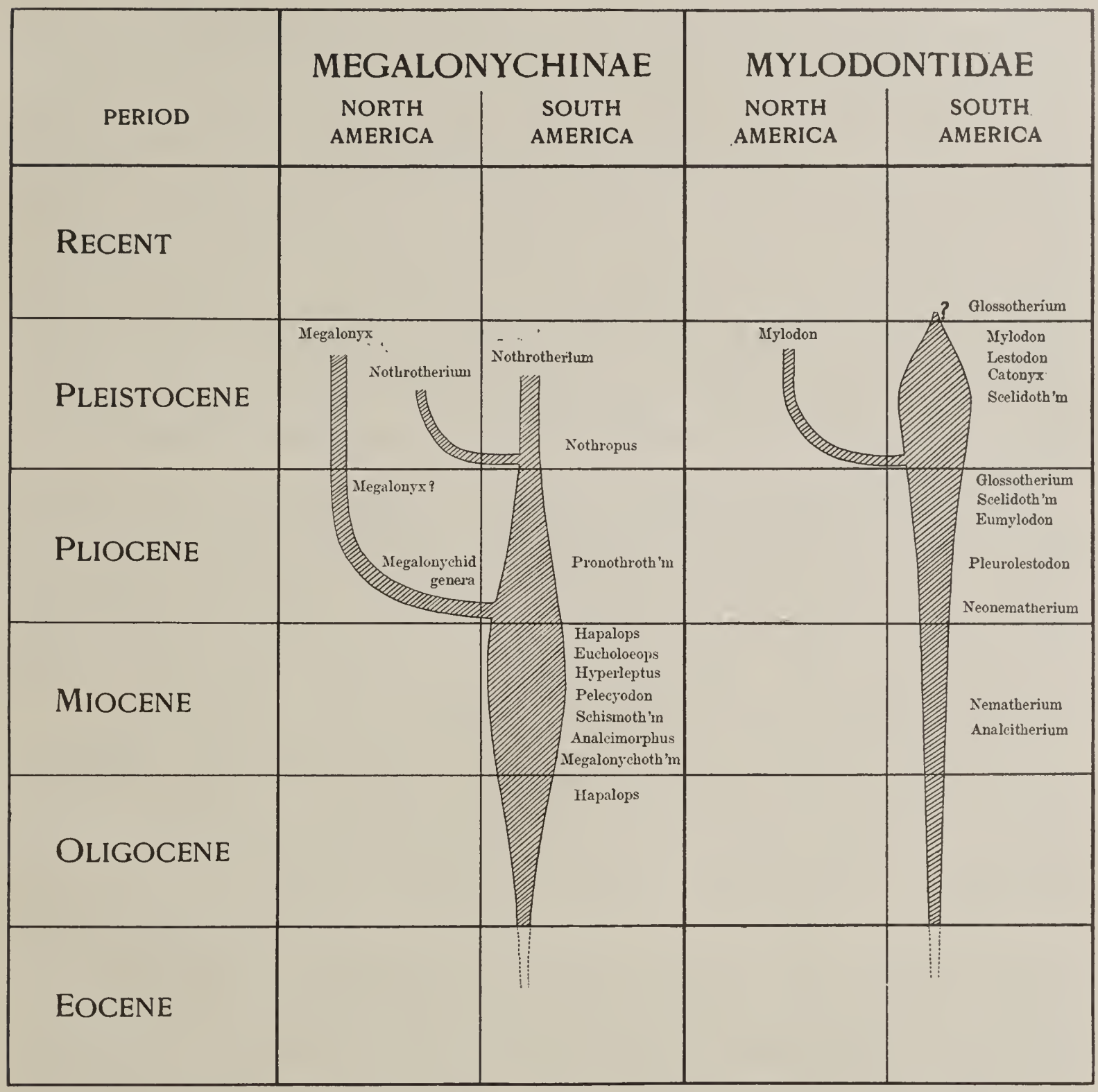

FIG. 1.—Chart showing geologic and geographic distribution of the Megalonychinae and Mylodontidae.

GEOLOGIC RANGE AND GEOGRAPHIC DISTRIBUTION OF THE MEGALONYCHINAE.

In contrast with the Mylodontidae and the Megatheriinae, the subfamily Megalonychinae is known by more abundant materials from Tertiary deposits of America, and of particular interest is the occurrence of members of this group to the apparent exclusion of the two other families in Pliocene deposits of the northern continent.

The megalonychid ground-sloths are definitely recorded from the Deseado Oligocene of South America, but it is quite unusual that they have here but a sparse representation, a fact which appears to be true for the entire edentate group at this period in the known Tertiary of the southern continent. Ground-sloths occurring in the Deseado formation have been referred by Ameghino to the genus *Hapalops*, a form found commonly in the following period. Loomis (1914) reaches the conclusion, from an analysis of the Deseado fauna, that the small percentage of edentates present in this assemblage of mammals is not to be attributed to an initial appearance of the group, for they are apparently close in stage of evolution to types of the Miocene and probably indicate in their structure an extended history antecedent to the Deseado accumulation. Loomis believes that the explanation for their meager representation should be sought rather in environmental factors less favorable than those extant during the deposition of the Santa Cruz beds.

The megalonychid ground-sloths were by far the most abundant forms of gravigrade edentates in the Santa Cruz mammalian assemblage of Miocene age. It is in this group that we secure the first adequate evidence as to the progenitors of Pleistocene types. According to Scott (1903–4), at least 7 genera are clearly distinguishable, this number being in decided contrast to the two incompletely known mylodont forms from these beds. The generic names are: *Hapalops, Hyperleptus, Eucholoeops, Megalonychotherium, Analcimorphus, Schismotherium, Pelecyodon.*

Hapalops is known by very complete and varied palaeontologic materials. Worth emphasizing is the great development of megalonychid forms during the Miocene, just antedating the earliest appearance of these ground-sloths in North America. It suggests that we should look to the Megalonychinae and not to the Mylodontidae or to the Megatheriinae as a probable source from which have been derived the gravigrade edentates appearing in the later Tertiary of the northern continent. The presence of megalonychid ground-sloths in Cenozoic beds in North America older than the Pleistocene or late Pliocene lends considerable support to this suggestion. Thus we may regard these early forms as the harbingers of the many ground-sloths that found their way northward during the Pleistocene. As suggested by Matthew (1915, p. 261), a possibility remains that the later Tertiary forms of North America are survivors from a primitive Paleocene-Eocene stock lingering in this region while the major evolution of the Xenarthra was taking place in the southern continent. It should be noted, furthermore, that, if this is actually the case, the later Tertiary ground-sloths of the northern continent would not show close relationship to either the middle Tertiary forms of South America

or to those types reaching North America during the Pleistocene. Scott (1904, p. 361) has already pointed out that the Upper Miocene Santa Cruz forms of Patagonia are less like the early Tertiary Ganodonta than are the Pleistocene genera, and are closely related to the latter types.

No remains of mylodont ground-sloths have been recorded from deposits older than Pleistocene in North America. In contrast to this record, several occurrences of megalonychid forms in Pliocene deposits are known, but unfortunately the remains are still very incomplete and fragmentary. Future search in the Lower and Middle Pliocene of North America will probably yield much better preserved material, thereby adding a very important chapter to the history of the group.

The presence of edentate-like remains in Middle Tertiary deposits of North America was announced by Dr. W. J. Sinclair (1906). The specimen described by Sinclair is a fragmentary ungual phalanx said to have been collected in the Middle Miocene Mascall deposits of eastern Oregon. Since the publication of this description doubt has been expressed as to the exact horizon from which the specimen was obtained. J. C. Merriam and W. D. Matthew (1915, p. 261) are inclined to the view that the ungual phalanx came originally from the Rattlesnake formation (Lower Pliocene). It is believed that in the course of erosion, now actively removing materials in the John Day region, the specimen was washed from Rattlesnake deposits and came to rest upon an exposed surface of the underlying Mascall beds. Ameghino (1912, p. 55) unhesitatingly accepted the occurrence of gravigrade edentates in the Mascall and regarded the fragmentary claw described by Sinclair as the type of the genus and species, *Sinclairia oregoniana*. On the basis of this occurrence, Ameghino postulated a land connection between North America and South America during Upper Miocene time. Reference to the ground-sloth specimen from the Rattlesnake beds will be made again in another section.

Megalonyx and *Megatherium* have been recorded from the Alachua formation in Florida. The two genera are known also from the Pleistocene of that State. In view of the fact that other ground-sloth remains in Lower Pliocene deposits of North America represent types with characters somewhat different from those of the Pleistocene genera, it appears rather doubtful whether the two forms mentioned actually ranged from the Pleistocene into the Lower Pliocene. Furthermore, Sellards[a] has remarked:

> "The vertebrate fauna of the Dunnellon formation and the Alachua Clays is practically the same, including the mastodon, rhinoceros, camel, and early horse. With these late Miocene or early Pliocene forms are found *Odocoileus, Tapirus, Megatherium*, and other late Pliocene or Pleistocene types. The mixing of fossils results unavoidably from the manner of accumulation of the deposits, for while the formation is believed to have accumulated chiefly during the Pliocene, yet sink formation having continued, later forms were carried into the deposits and mixed with the earlier."

Leaving aside the doubtful occurrences of ground-sloths in the Mascall deposits and in the Alachua Clays, there still remains the presence of possible megalonychids in the Snake Creek beds of Nebraska, in the Rattlesnake beds of eastern Oregon, and in the Orinda of Middle California. Ground-sloths definitely related to the Megalonychinae are known also from the Eden and San Timoteo horizons of

[a] E. H. Sellards, The relation between the Dunnellon formation and the Alachua clays of Florida, 6th Ann. Rpt. Fla. State Geol. Surv., p. 162, 1914.

Southern California and from the Blanco of Texas. The authentic records of megalonychid ground-sloths in the Pliocene of North America seem, then, to favor the view that these forms are derivatives from a South American center of dispersal. If we assume this to be true, we are led to believe that at least two incursions from South America have taken place during the latter half of the Cenozoic, one during the early Pliocene or just prior to this period, the other in the Pleistocene.

Members of the Megalonychinae from Pliocene deposits of Mexico, should they be found in beds of that age, would undoubtedly aid in establishing more definitely the relationship of the North American and South American ground-sloths of the later Tertiary.

TABLE 1.—*Known occurrences of later Tertiary ground-sloths of North America.*

Form.	Material.	Deposit.	Age.
Edentate-like	Ungual phalanx	Mascall(?)	Middle Miocene.
Megatherium		Alachua	Lower Pliocene.
Megalonyx sp	Toe-bone	Alachua	Lower Pliocene.
Megalonychid(?)	Claw, navicular	Snake Creek	Lower Pliocene.
Megalonychid(?)	Metapodial	Rattlesnake	Lower Pliocene.
Megalonychid(?)	Tooth	Orinda	Lower Pliocene.
Nothrotherium? or Pronothrotherium? sp	Tooth	Eden	Lower Pliocene.
Megalonyx sp	Tooth	Eden	Lower Pliocene.
Megalonyx? sp	Teeth	San Timoteo	Lower Upper Pliocene.
Megalonyx leptostomus Cope	Skull fragments and tooth	Blanco	Upper Pliocene.

In the Pliocene of South America the record of the Megalonychinae is still fragmentary, the material described at present being much less abundant than that of the Santa Cruz stage. Rovereto (1914) has reviewed the occurrence of mammals in various deposits of the later Tertiary, and from this study one may infer that these ground-sloths were not so well represented in the Pliocene as were members of the Mylodontidae. They have been obtained only from one horizon, namely, the Araucanian, at Catamarca, northwestern Argentina. The types found are *Pronothrotherium typicum* Ameghino and *Pyramiodontherium dubium* described by Rovereto. The former genus is currently regarded as occupying a position in the phylogenetic series between *Hapalops* of the Miocene and *Nothrotherium* of the Pleistocene. Whether or not this form is related to any of the Pliocene megalonychid ground-sloths of North America is still a matter of conjecture, but future discovery may demonstrate such a relationship.

During the Pleistocene the North and South American members of the Megalonychinae show interesting resemblances and differences. The genus *Nothrotherium* is now known to have ranged from Brazil northward into Texas and California. It has been found in cave deposits in the Brazilian region and in similar accumulations in the mountain provinces of California. In western North America *Nothrotherium* seems to have been especially characteristic of the more elevated forested regions, but such a range did not necessarily preclude its presence in particularly favored localities, as at Rancho La Brea. The distribution of the genus *Megalonyx* stands in contrast to that of *Nothrotherium*. This form is found mainly in asso-

ciation with forest faunas of the Pleistocene and seems to have been indigenous to the North American continent, where it has undergone considerable specific differentiation. The distribution of *Megalonyx* is rather unusual, for although the genus enjoys as extensive a range in North America as *Mylodon* and exceeds *Nothrotherium* in this respect, it still remains completely unknown in South American faunas. In the southern continent, during the Pleistocene, other megalonychid ground-sloths appear, as shown by the genus *Nothropus* and by the unidentified form recorded from Peru by Nordenskiöld (1908). The distribution of *Megalonyx* should be credited with due consideration, for it may indicate that the genus has evolved on the North American continent from some Pliocene descendant of the Santa Cruz Megalonychinae and has resided here for a longer period than *Nothrotherium*.

Attention should now be directed to the presence of very interesting types of ground-sloths in Cenozoic deposits of the Greater Antilles. Remains of these mammals from the island of Cuba were recognized by Leidy as belonging to a form closely related to the North American *Megalonyx* and were referred to under the generic name *Megalocnus*. Several years ago, Anthony (1918) described another type, *Acratocnus*, from the island of Porto Rico. Recently, Matthew (1919) has added the three genera *Mesocnus*, *Miocnus*, and *Microcnus* to the mammalian assemblage known from cave, fissure, and spring deposits of Cuba.

All the ground-sloths from the Greater Antilles are of small size and are undoubtedly related to the still smaller forms from the Santa Cruz Miocene of South America. To account for their presence on the islands of the West Indies, we are led to postulate either a migration of types during the later Tertiary from the continental areas to the south or west or a conveyance of these forms on natural rafts, as suggested by Matthew. Geological and faunal evidence gives no support to the possibility of a Tertiary land connection between the Antillean land-mass and North America. The Pleistocene ground-sloths found in the Greater Antilles must then be regarded as representatives of culminating stages in a development under the influence of conditions of insular isolation operating for a long period of time, as suggested by Matthew (1915, p. 204).

When due allowance is made for the structural features acquired as a result of isolation, *Megalocnus*, *Acratocnus*, and possibly the three genera described by Matthew possess certain characters in common and form a group which should be distinguished from *Nothrotherium* and related types. This evidence may be cited, perhaps, in support of a belief that *Megalonyx*, *Acratocnus*, *Megalocnus*, and other Cuban ground-sloths are Pleistocene derivatives from a common ancestry, some members of which during the Pliocene invaded North America from the southern continent by way of Central America, while others found their way into the Antillean land-mass. Thus would be explained incidentally the absence of *Megalonyx* in the Pleistocene of South America, a fact which stands in decided contrast to the range of *Nothrotherium*. With an earlier entrance into North America *Megalonyx* became better adjusted to the northern biotic and physical environments than did *Nothrotherium*, thereby accentuating their structural differences and permitting greater specific differentiation within the former genus.

OCCURRENCE AND DESCRIPTION OF REMAINS PROBABLY BELONGING TO MEMBERS OF THE MEGALONYCHINAE IN TERTIARY BEDS OF WESTERN NORTH AMERICA.

RATTLESNAKE FORMATION, EASTERN OREGON.

Mention has been made of the edentate-like ungual phalanx described by Sinclair (1906) from the Mascall Middle Miocene of the John Day region, eastern Oregon. The specimen (No. 1096 U. C. C.) is shown in figure 2, A, B, C. Much additional information of the later Tertiary beds and faunas of the John Day region is now available. It is generally regarded that the ungual phalanx came originally from the Rattlesnake Lower Pliocene deposits that overlie unconformably the Mascall beds. The mammalian fauna known from the Rattlesnake[a] is listed as follows:

?Canis davisi Merriam.
Amphicyon, near amnicola Matthew and Cook.
Mustela sp. *a*.
Mustela sp. *b*.
Felis, large sp.
Indarctos? oregonensis Merriam, Stock, and Moody.
Lepus? sp.
Dipoides? sp.
Megalonychid? gen. and sp. indet.
Prosthennops sp.
Alticamelus altus (Marsh).
Pliauchenia sp.
Procamelus sp.
Sphenophalos, near nevadanus Merriam.
Ilingoceros? sp.
Teleoceras fossiger (Cope).
Hipparion sinclairii Wortman.
Hipparion, near occidentale Leidy.
Hipparion, near anthonyi Merriam.
Pliohippus, near fairbanksi Merriam.
Pliohippus spectans (Cope).
Tetrabelodon? sp.

One of the results of the University of California expedition to the John Day region in 1916 was the discovery of a single fragmentary metapodial (No. 22900 U. C. C.) of a gravigrade edentate in deposits of Rattlesnake age. Unfortunately, the specimen has suffered injury during preservation and contributes little to our knowledge of the skeleton of North American ground-sloths of the later Tertiary. It is important, however, in establishing definitely the occurrence of these forms in the Lower Pliocene of eastern Oregon.

In the metapodial (No. 22900 U. C. C., figure 2, F, G,) from the Rattlesnake beds, one of the sides and the greater part of the proximal end have been broken away. On the side that is best preserved the facet for the adjoining metapodial is intact, while only a small portion of the mesopodial surface remains. At the distal end the carina is preserved, as well as an articulating offset along one of the sides.

No. 22900 is short and stout. The lateral wall of the shaft is at right angles to that portion of the dorsal surface which still remains. It indicates that the metapodial possessed a relatively deep shaft and that the latter was presumably quadrilateral in section. The lateral facet for adjoining metapodial is flat and oval and is directed outward and downward. The proximal margin of this facet is not closely approached by the mesopodial surface, but this may be due in part to the worn condition of the specimen. The remaining portion of the mesopodial surface

[a] From unpublished manuscript of Merriam, Stock, and Moody.
J. C. Merriam, Relationships of Pliocene mammalian faunas from the Pacific Coast and Great Basin provinces of North America. Univ. Calif. Publ., Bull. Dept. Geol., vol. 10, No. 22, p. 428, 1917.

is but slightly concave transversely and does not reach the dorsal margin of the proximal end. Although an offset flanks the lower portion of the distal carina on one side, there was apparently not an extensive offset present on the opposite side.

The Rattlesnake specimen resembles the third metacarpal of *Hapalops* in quadrilateral cross-section of shaft. It differs, however, from this element in having a relatively shorter and deeper shaft. In *Hapalops* the proximal facet of the inner side is more extensive dorso-ventrally, is directed for the most part proximo-internally, and is of an entirely different shape than in No. 22900. The dorsal margin of the proximal end in the latter specimen was not deeply indented

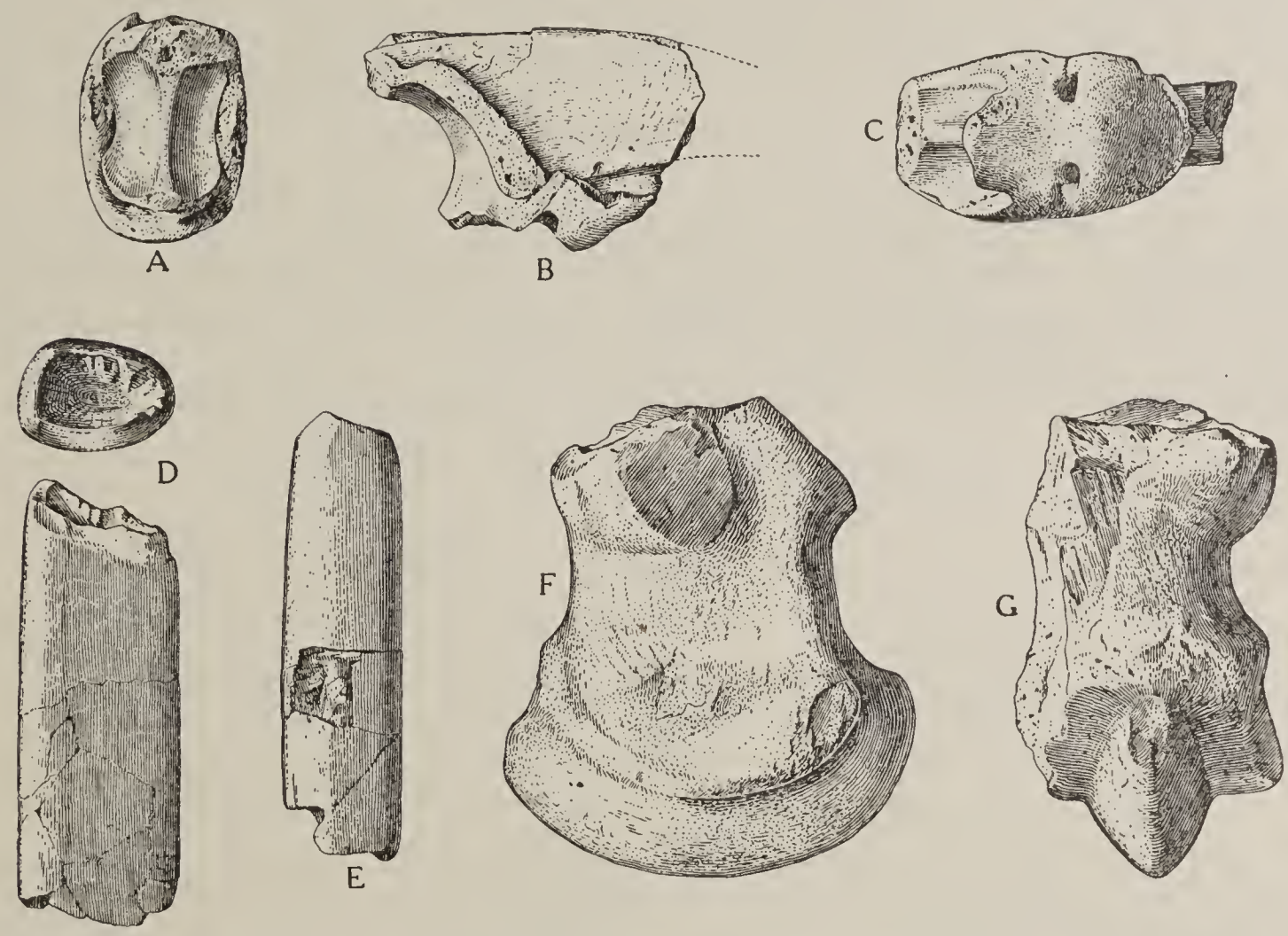

FIG. 2.—*A* to *G*, ground-sloth remains from Tertiary beds of Western North America. *A*, *B*, and *C*, ungual phalanx, No. 1096 U. C. C., from Rattlesnake formation, Eastern Oregon; *D* and *E*, tooth No. 22110 U. C. C. from Pinole Tuff-Orinda-Siesta deposits, middle California; *F* and *G*, metapodial, No. 22900 U. C. C., from Rattlesnake formation, Eastern Oregon. All figures × 1.

in middle line as in the Miocene form. The distal carina in *Hapalops* is slightly more prominent dorsally and the inner offset is also more extensive above than is the offset preserved in the Pliocene metapodial.

Metacarpal III of *Megalonyx jeffersonii* is approximately twice as long as No. 22900 from the Pliocene. The shaft in the Pleistocene genus is relatively shorter than in *Hapalops*, but not as short as in the Rattlesnake specimen.

With metatarsal II of *H. elongatus* certain differences and resemblances are to be noted. No. 22900 is relatively shorter and the shaft deeper; the lateral facet is small and flattened, while in *Hapalops* the facet for metatarsal I is relatively large and concave dorso-ventrally; the offset, which is preserved at the distal end,

is less extensively developed. In the metatarsal of *Hapalops* (No. 15545 Princeton Univ. Coll.) under observation, the lateral facet articulating with the first metapodial has much the same position and is directed downward in much the same manner as the facet in No. 22900. Below this facet in the Rattlesnake specimen there is some indication of a small knob or boss, as in the second metatarsal from the Santa Cruz beds. Dr. W. J. Sinclair, who has kindly examined a plaster cast of the Rattlesnake specimen, is of the opinion that it represents a second metatarsal and refers it to the right pes. Dr. Sinclair remarks that the proximal surface is flatter than in *Hapalops*, and in metatarsal II of the latter genus and of *Analcimorphus* this facet and the anterior (dorsal) surface meet in a markedly concave margin, which is not the case in the Pliocene form. If the specimen does represent the second metatarsal, then the inner facet (fig. 2, F) is for the first metatarsal and the proximal surface for the mesocuneiform, as stated by Dr. Sinclair.

Presuming that the claw-phalanx described by Sinclair did come from the Rattlesnake, it is still difficult to make a satisfactory comparison with the second specimen now at hand. In a consideration of size the metapodial appears to pertain to an individual larger than that to which the claw belonged, although sufficient information concerning structure of the feet in Pliocene ground-sloths of North America is not available to warrant even such comparison.

TABLE 2.—*Comparative measurements (in millimeters).*

	Length through middle.	Depth of distal carina.	Least depth of shaft.
No. 22900, Rattlesnake	[1]52	46.8	30.3
Hapalops elongatus, metatarsal II, No. 15545, Santa Cruz	20.6	16.2	7.6
Analcimorphus, sp.[2] metatarsal II, Santa Cruz	30.3	7.6	15

[1]Approximate. [2]Measurements taken by W. J. Sinclair.

PINOLE TUFF-ORINDA-SIESTA DEPOSITS, MIDDLE CALIFORNIA.

A single tooth (No. 22110 U. C. C.), presumably of a megalonychid ground-sloth, has been found at University of California locality 2572, in the Pinole Tuff-Orinda-Siesta deposits exposed along San Pablo Bay, near the station of Pinole, California. The locality occurs in beds immediately overlying the Pinole tuff. The deposits have been folded and are regarded as of Lower Pliocene age. The mammalian fauna collected at locality 2572 consists of the following forms:[a]

Tephrocyon sp.
Martes sp.
Hypolagus sp.
Megalonychid, probably n. g. and n. sp.
Antelope, near Sphenophalos.
Pliohippus, near fairbanksi Merriam.

No. 22110 (fig. 2, D, E) is smaller than teeth of most species of *Megalonyx* and approaches in its dimensions the teeth of *Nothrotherium*. It does not agree with any of the teeth of the latter genus in shape or in wear of occlusal surface. It lacks also the distinct longitudinal grooves on the lateral sides, a character occurring commonly in teeth of Pleistocene megalonychids. Cheek-teeth of *Megalonyx*

[a] J. C. Merriam and C. Stock, manuscript in preparation.
J. C. Merriam, Relationships of Pliocene mammalian faunas from the Pacific Coast and Great Basin provinces of North America. Univ. Calif. Publ., Bull. Dept. Geol., vol. 10, p. 425, 1917.

wheatleyi from the Pleistocene of Port Kennedy fissure are, according to measurements given by Cope, relatively wider transversely than the Pinole specimen.

The tooth from near Pinole is well rounded on one of the lateral sides, with the opposite side nearly flat. The anterior and posterior faces are flattened or broadly convex and meet the flattened lateral face in well-rounded angles. On the occlusal surface of No. 22110 the flattened lateral side has suffered least wear and is presented as a strong ridge. The rounded side, on the other hand, is most worn, and the anterior and posterior sides are beveled. The middle of the occlusal surface is deeply excavated, but it is not quite certain how much of this was acquired during the life of the animal. The crown of the Pinole tooth is approximately of same diameter throughout its length. The transverse diameter is 17 mm., the antero-posterior diameter 12.3 mm.

SAN TIMOTEO AND EDEN BEDS, SOUTHERN CALIFORNIA.

The important Cenozoic mammalian faunas from southern California described by Mr. Childs Frick[a] include members of the ground-sloth group. Megalonychid types are recorded from two Pliocene horizons. The assemblage from the San Timoteo beds is regarded by Frick[b] to be close in age to the Blanco fauna of Texas and consists of the following forms:

Megalonyx? sp.
Pliauchenia? sp.
Camelid, small sp.
Cervid (?), medium, n. sp.
Pliohippus francescana Frick.
Pliohippus francescana minor Frick.

One of the two ground-sloth specimens described by Frick from the San Timoteo is a last upper tooth, No. 23373 U. C. C., of small size and similar in shape to corresponding teeth of *Megalonyx*.

The Eden assemblage is older than that from the San Timoteo and is regarded by Frick as representing a late faunal phase of the Lower Pliocene. The list of mammals is given in table 3.

TABLE 3.—*List of mammals.*

Canis? sp.	Platygonus? sp.	Antilocapra? sp.
Felis? sp.	Pliauchenia merriami Frick.	Pliohippus osborni Frick.
Smilodon? sp.	Pliauchenia sp. A.	Pliohippus osborni subform A.
Hyaenarctos gregoryi Frick.	Procamelus edensis edensis Frick.	Pliohippus edensis Frick.
Hypolagus edensis Frick.	Procamelus edensis raki Frick.	Pliohippus edensis subform A.
Nothrotherium? or Pronothrotherium? sp.	Procamelus, n. sp.	Pliohippus edensis subform B.
Megalonyx? sp.	Cervid sp	Trilophodon shepardi edensis Frick.
Prosthennops edensis Frick.	Merycodus? or Ilingoceros?	

The megalonychid remains from the Eden consist of fragmentary teeth. No. 23374 U. C. C. is referred tentatively by Frick[c] to *Nothrotherium* or *Pronothrotherium*. It is remarkably similar to teeth of the Pleistocene *Nothrotherium* from Rancho La Brea, and clearly indicates the presence of a nearly related form in the Pliocene.

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[a] C. Frick. Extinct vertebrate faunas of the badlands of Bautista Creek and San Timoteo Cañon, Southern California. Univ. Calif. Publ., Bull. Dept. Geol., vol. 12, No. 5, pp. 277–424; plates 43–50, 1921.

[b] *Ibid.*, p. 320, fig. 29*a*.

[c] *Ibid.*, pp. 349–350, fig. 56*a*.

HABITAT OF THE MEGALONYCHINAE AS SUGGESTED BY OCCURRENCE.

When the history of the Megalonychinae is viewed in its entirety a noticeable change is to be observed in the relation which members of this group bear to their environment, a change undergone during their period of evolution from the Miocene to the Pleistocene. The difference in ecologic relationships witnessed in this subfamily of ground-sloths exemplifies again the vicissitudes attending the history of the mammalia throughout the Cenozoic, and some of the agencies which underlie these changing conditions are of particular significance in the modification of mammalian types. It is evident that adaptability to new sets of conditions permitted the megalonychid ground-sloths to extend their geographic range considerably, and the seeming readiness with which this has been accomplished probably explains, or at least is connected suggestively with, the somewhat different history of the group in North America in contrast to the Mylodontidae.

It is an unusual fact that the ground-sloths, while they have a remarkable development during the Santa Cruz period in South America, are but meagerly recorded from the older stage, the Deseado. Loomis (1914) attributes this sparsity of edentates in the Deseado fauna to an environment which was not favorable to the group. The Deseado mammalian fauna has, however, much in common with that of the Santa Cruz in its biotic and physical relationships and is presumably not distantly removed from the latter assemblage in stage of evolution. In a discussion of the Deseado fauna as collected by the Amherst Patagonian expedition, Loomis (1914, p. 24) states:

> "Of our fauna, 11 per cent were flesh or insect eating, and for the purpose of determining the type of country may best be omitted. The rodents could have been either forest or open-country forms. Of the remaining 54 per cent, the typotheres, the litopternas, the *Rhynchippidae*, the *Leontinidae*, the nesodonts and the birds (46 per cent) were distinctly adapted to live on hard ground, the other 8 per cent being evidently suited to living near a river. All 54 per cent ate either grass or browse. The litopternas are grass eaters; the typotheres were specialized to eat grass or bark; nesodonts, *Leontinidae*, and *Rhynchippidae* are grass- and browse-eaters. Even the *Pyrotherium* has a pair of gnawing tushes. The picture arising from these considerations is a bush-covered prairie, a country not unlike the upland bush pampas of Patagonia to-day."

According to Loomis, the edentates form 8 per cent of the Deseado fauna. The types found here are but slightly less advanced than those known from the Santa Cruz beds. As a matter of fact, the entire Deseado mammalian fauna bears considerable similarity to that of the Santa Cruz and indicates that it is not separated from the latter by a very great time-interval.

In the Santa Cruz beds the edentates comprise over 50 per cent of the mammalian fauna, and of this group the ground-sloths, particularly members of the Megalonychinae, are very numerous. The animals associated with the megalonychid forms during Santa Cruz time are presented in table 4, compiled from the works of Scott and others, wherein families are the smallest units given.

The type of environment prevailing during the period of accumulation of the Santa Cruz beds, suggested by the deposits and their faunal content, was apparently not greatly different from that found on the prairies or pampas now present in the Patagonian region. J. B. Hatcher,[a] in a discussion of the geography of southern

[a] J. B. Hatcher. Rpts. Prin. Univ. Exp. to Patagonia, 1896–1899, vol. 1, Narrative and geography, p. 235, 1903.

Patagonia published with the narrative of the expeditions to Patagonia, has commented on this subject in part as follows:

"During and after the deposition of the Santa Cruzian beds in Miocene and early Pliocene times, this region was a broad but little-elevated plain, with numerous and extensive marshes, but no real mountains then existed where now are the Andes."

Our knowledge concerning the Pliocene ground-sloths, both of the northern and southern continents, is still far less complete than that of the forms from the preceding or following geologic periods. No extended effort is made at present to segregate the various American mammalian faunas of the Pliocene on the basis of environmental facies represented, primarily because of the sparsity of materials. It is on this account that our concept of the true ecologic relationships of the Pliocene gravigrade edentates must remain for a time in the formative stage. The record of megalonychid forms in such North American Pliocene assemblages as the Rattlesnake, Eden, San Timoteo, Blanco, and others may be interpreted, perhaps, as pointing toward a biotic association and a physical environment somewhat different from those in which members of the Megalonychinae were found during the Pleistocene.

TABLE 4.—*List of mammalian groups represented in Santa Cruz beds.*

Marsupalia.
- Polyprotodontia.
  - Thylacynidae.
  - Didelphyidae.
- Diprotodontia.
  - Caenolestidae.

Insectivora.
- Necrolestidae.

Rodentia.
- Hystricomorpha.
  - Octodontidae.
  - Erethizontidae.
  - Chinchillidae.
  - Caviidae.

Edentata.
- Dasypoda.
  - Tatuidae.
  - Dasypodidae.
  - Peltephilidae.
- Glyptodontia.
  - Glyptodontidae.
- ?Doedicuridae.

Gravigrada.
- Megalonychidae.
- Planopsidae.
- Mylodontidae.

Toxodonta.
- Toxodontidae.
- Notohippidae.

Entelonychia.

Typotheria.
- Interatheriidae.
- Hegetotheriidae.

Litopterna.
- Protcrotheriidae.
- Macrauchenidae.

With the coming of the Glacial Epoch a decided change is to be noted in the ecologic relationships of the megalonychid division of the ground-sloth group. Cope, long ago, made the fundamental distinction between the mammalian assemblages of this period on the basis of plains and forest habitat. The group of mammals from the *Equus* beds of the western United States, which included *Mylodon* and typified the former environment, was contrasted by Cope with the fauna secured from eastern cave deposits. The latter assemblage was characterized by the presence of *Megalonyx*, with which, however, *Mylodon* and *Megatherium* were occasionally associated. The importance of the former genus in this fauna is revealed by the designation *Megalonyx* beds, which Cope applied to the horizons containing the forest fauna. With the palaeontological investigation of cave deposits in California, mammalian assemblages were disclosed that possess much in common with those obtained in similar beds of the eastern United States. A somewhat similar contrast can probably be made between the mammalian aggregates that lived in the forested regions and on the prairies of South America during the Pleistocene. Branco,[a] in an interesting and valuable study, has con-

[a] W. Branco. Über eine fossile säugethier-fauna von Punin bei Riobamba in Ecuador. Palae. Abhdl., vol. 1, pp. 185–198, 1883.

trasted the late Cenozoic faunas of South America with those of North America. Branco concerned himself particularly with the determination of age of these horizons, but from his studies there becomes apparent a certain degree of similarity of relationship when the mammalian faunas from pampa deposits and from the Brazilian caves are compared to the corresponding *Equus-Mylodon* fauna and *Megalonyx* fauna of the northern continent.

Herluf Winge's researches on the collections obtained by Lund from the Brazilian caverns resulted in the recognition of a long list of mammals known from these accumulations. *Nothrotherium* is a typical member of this assemblage. It may be readily conceded that in such a region as Brazil, where probably during the Pleistocene, as at the present time, open savannahs were associated with dense forests or jungles, there would of necessity be a representation of some mammalian types characteristic of the pampas. The horses, camels, litopterns, and some edentates may perhaps be cited as belonging to this group. In California similar associations of forest and plains mammals are known. At Hawver Cave, in Eldorado County, the Pleistocene mammalian assemblage includes also types living normally under the environment found in the Great Valley of California. An association of mammalian forms living usually in separate environments is likewise quite as possible where accumulation is occurring on open stretches of country in proximity to forested areas and where a certain amount of intermingling of faunas takes place. Under these conditions it is but natural to expect the presence of occasional forest types in the fossil record. Such association of types has probably taken place to some extent in the Rancho La Brea beds. In a survey of the cave deposits of California and their contained Pleistocene faunas it has been suggested (Stock, 1918) that only three genera of the larger mammals so far known, namely, *Megalonyx*, *Nothrotherium*, and *Euceratherium*,[a] are to be regarded as specially characteristic of the eastern mountain belt of the State.

GEOLOGIC RANGE AND GEOGRAPHIC DISTRIBUTION OF THE MYLODONTIDAE.

Among the earliest gravigrade edentates, known as yet only by fragmentary remains from the Deseado formation of South America, presumably of Oligocene age, are forms which in some characters bear resemblance to mylodont ground-sloths, but with the incompleteness and paucity of materials available it is hazardous to assert their true relationships. Such, for example, is the genus *Octodontotherium* described by Ameghino (see Loomis, 1914).

Remains of ground-sloths undoubtedly belonging to the family Mylodontidae have been described, principally by Ameghino, Lydekker, and Scott, in studies of the Upper Miocene vertebrate fauna from the Santa Cruz beds of Patagonia. The fauna from these deposits, in comparison to that from the Deseado, includes the ground-sloths as an integral part. It is a curious fact, however, as noted by Scott, that the family Mylodontidae, in contrast to the Megalonychinae, is represented in the Santa Cruz beds by relatively few types. Only two genera are

[a] *Preptoceras* should probably be placed with this group.

recognized by Scott, namely, *Nematherium* and *Analcitherium*. It is, of course, possible that, when palaeontologic investigations have been extended to other Middle Tertiary deposits of South America, this rare occurrence of mylodont ground-sloths during accumulation of the Santa Cruz sediments will lose the significance which may be attached to it at present.

Mylodont ground-sloths have been described from several Pliocene horizons in South America, but the family is not known to be represented in beds of that period in North America. In the light of recent investigations of Pliocene mammalian faunas of the northern continental region, it seems reasonable to suppose that the mylodont ground-sloths did not reach North America until Pleistocene time.[a] The sparse representation of the Mylodontidae in South America during the Miocene may be responsible for the absence of the group in the Pliocene of North America.

Recently the Pliocene faunas of South America have been considered in detail by Rovereto (1914), who distinguished four divisions or stages. These are, proceeding from youngest to oldest:

1. Chapalmalian. 2. Hermosian. 3. Araucanian. 4. Rionegrian.

From the type locality of the Chapalmalian the following members of the Mylodontidae are listed by Rovereto:

Glossotherium sp.
Scelidodon rothi Ameghino.
Scelidotherium chapalmalense Ameghino.
Eumylodon sp.

The Pliocene fauna from the Hermosian at the type locality, Monte Hermoso, includes:

Scelidodon patrius Ameghino.
Scelidodon pendolai Rovereto.

The following mylodont forms are recorded from the type locality of the Araucanian in the valley of Santa Maria, province Catamarca:

Scelidodon almagroi Rovereto.
Sphenotherus zavaletianus Ameghino.
Pleurolestodon acutidens Rovereto.
Pleurolestodon avitus Rovereto.
Pleurolestodon macrodon Rovereto.

Finally, Rovereto lists the genus *Neonematherium* from deposits assigned to the Rionegrian stage as exposed in the valley of the Rio Negro and occurring also at various localities in Patagonia.

The present writer is not in a position to review critically the status of the forms recorded above from the Pliocene of South America. The genus known from the earliest stage is related to a preceding type found in the Santa Cruz, while in the latest stage of the Pliocene, as recognized by Rovereto, several of the mylodont ground-sloths are generically the same as Pleistocene forms. It may be also noted that in general the Pliocene types are transitional in character of size, occupying a position between the mylodonts of the Miocene and those of the Pleistocene.

During the Pleistocene the Mylodontidae enjoyed their greatest geographic distribution. Having occupied South America since pre-Miocene time, it is not

[a] The genus *Mylodon* has been recorded from the Blanco Pliocene deposits of Texas, but this statement is asserted by W. D. Matthew to be an error.

surprising to find the group ranging over the southern continent toward the close of the Tertiary. With establishment of a land connection between the two continents at about this time, these ground-sloths would perhaps be among the first of the South American fauna to avail themselves of the opportunity to migrate northward. Their entry into North America probably occurred by way of Central America and the Isthmus of Panama, but little mylodont material has been recorded as yet from these regions and from Mexico. Aside from an occurrence of a fragmentary arm-bone of *Mylodon* in Central America, noted by Leidy (1870), and the presence of a mylodont tibia in the Mexican Pleistocene,[a] no other remains are known to the writer. In the Antillean region, where the megalonychid ground-sloths are surprisingly well represented in Pleistocene deposits, the mylodont types are unknown.

While no less than five valid mylodont genera have been described from the Pleistocene of South America, only one genus, *Mylodon*, is known from deposits of similar age in North America. Although the physical environment in North America may not have offered serious disadvantages to an extensive deployment of the group, a more potent factor in limiting the range of the mylodont ground-sloths would seem to be the efficacy of the biotic barrier as established by the carnivore group. In this regard it should be noted that just prior to the entrance of *Mylodon* into North America there were present in the late Pliocene mammalian faunas of this continent several formidable types, as, for example, *Ischryosmilus*, *Felis*, *Hyaenognathus*, and *Borophagus*. *Mylodon* is exceptionally well represented in western North America, an indication perhaps of closer proximity of this province to the avenue of migration from the south. With the advent of *Mylodon* into North America during the Pleistocene, the distribution of the Mylodontidae was greatly extended. This is particularly well shown by the latitudinal range of the family, which reached from approximately 51° south to approximately 47° north of the equator. No other group of the larger mammals indigenous to the South American continent ranged over so vast a territory during the Pleistocene.

HABITAT OF THE MYLODONTIDAE AS SUGGESTED BY OCCURRENCE.

Obviously, an attempt to portray the habits of members of the Mylodontidae can be materially aided by a consideration of the structural characteristics possessed by these forms, and by an investigation of their habitat. A correct interpretation of the physical environment in which the mylodont sloths maintained themselves is more likely to be derived when both the mode of occurrence and particularly their biotic associations are carefully examined. In viewing such a mammalian assemblage it may be readily conceded that a better understanding of the activities and adaptations of the ground-sloths is reached, for the position held by any animal in the economy of Nature can be judged correctly only in the

[a] W. Freudenberg. *Op. cit.*, plate 1 (20), fig. 2, 1910. The tibia figured by Freudenberg is referred to *Oryctotherium*. This generic name is synonymous with *Mylodon*.

light of the internal and external factors which more or less control or influence its existence.

Possessed of many unusual features in skeletal structures, these ground-sloths must have offered a pronounced contrast to the more progressive types of mammals indigenous to the North American continent with which they were associated during the Pleistocene. Since the mylodont sloths form an integral part of the Pleistocene fauna of South America, and as there is apparently no reason for believing that they occupied a physical environment decidedly different from that in which they moved in North America, the information relating to these southern forms should render much aid in our discussion of the northern types. As a matter of fact, Branco[a] indicated a number of years ago the fundamental similarity which exists between the Pleistocene mammalian faunas of North and South America so far as the broader zonal distribution of the mammalia during this period is concerned.

That *Mylodon* and related genera were inhabitants of the great stretches of open country, the pampas or steppes, in South America seems definitely established by their occurrence and faunal association at several of the most noteworthy localities. Mylodont genera appear also to have been restricted less in their altitudinal range than other types of the larger herbivorous mammals. Let us briefly review some of these occurrences.

Argentina.—The discovery of large Pleistocene quadrupeds, including a number of gravigrade edentates, in the Pampean formation of Argentina, by Charles Darwin, is recorded in the chronicles of his researches while on the voyage of the *Beagle*. From alluvial deposits exposed at Punta Alta, in Bahia Blanca, remains of edentates belonging to the Megatheriidae, Mylodontidae, and Glyptodontidae were collected by Darwin[b] in association with fossil material of a horse, *Macrauchenia*, and *Toxodon*. The fauna is typically one which characterized the South American pampas during the Pleistocene.

Patagonia.—The occurrence of the mylodont sloth *Grypotherium* in the great cavern located at Ultima Esperanza, Last Hope Inlet, in magellanic South America, has attracted considerable attention because of the valuable materials that have been preserved. It is desirable to review at this time certain of the distinctive features of the find. Not only were the bones of *Grypotherium* recovered, but integumentary parts and specimens of the droppings of this animal were also secured. It has been found possible, therefore, to reach a more specific inference as to the probable appearance and activity of the form than could otherwise be obtained from examination of only skeletal material, and this in turn aids in an understanding of the environment in which the animal lived.

The mammals found associated with *Grypotherium* consist of the following types:

Felis sp., extinct.
Felis concolor, living.
Arctotherium sp., extinct.
Lyncodon patagonicus, living.
Megamys sp., extinct.
Ctenomys magellanicus, living.
Macrauchenia sp., extinct.
Onohippidium saldiasi Roth, extinct.
Lama huanacos, living.

[a] W. Branco. *Op. cit.*, 1883.

[b] C. Darwin. Journal of researches into the natural history and geology of the countries visited during the voyage of H. M. S. *Beagle* around the world, under the command of Capt. Fitz Roy, R. N., Appleton & Co. 1896.

According to some investigators, man should be included in this fauna, or perhaps some division of it.

In this faunal assemblage we note several types indicative of a plains environment, or at least one in which considerable stretches of open country were available. Confirmatory evidence that *Grypotherium* lived under conditions such as are suggested by its faunal association is offered also by an examination of materials constituting the specimens of excrement of this animal. To quote from Smith Woodward (1900):

"Mr. Spencer Moore has kindly examined them from the botanist's point of view and reports that they are composed 'in large part apparently of grasses, as the haulms, leaf-sheaths, fragments of leaves, etc., of these plants are frequent in the mass. A spikelet, almost entire, of what seems to be a species of *Poa*, and the flowering glume of another grass, probably avenaceous, have also been found. Besides these there are at least two dicotyledonous plants, one herbaceous and the other almost certainly so, the latter having a slender greatly sclerotized stem. Unfortunately, as no leaves have hitherto been observed attached to the fragments of stem, their affinities are altogether doubtful. There are numerous siliceous particles in the excrement, and there are many pieces of the underground parts of plants, suggesting that they have been pulled out of the ground. A few pieces of stems are sharply cut, not bruised or torn at the end.'"

Similar material has been carefully examined by Richters (1904), who reports as follows:

"Die Hauptmasse des pflanzlichen Materials, aus dem der Dung besteht, sind Teile von Gramineen: Halm-Bruchstücke, Blatt- und Spelzenreste: Epidermisgewebe deuten sowohl auf glatte wie behaarte Formen hin. Häufig kommen durch Maceration freigewordene, derbe, verästelte Gefässbündel eines, wie es scheint, kahnförmigen Blattgebildes, andererseits derbe, durch die Verdauung kaum beeinflusste Blätter mit dornigem Rande vor. Ein durch seine mäanderförmigen Zellgrenzen ausgezeichnetes Epidermisgewebe mit ringförmigen Wulsten, auf denen Haare standen, deutet auf eine Dicotyledone hin: ebenso eine kleine Frucht, die etwa an ein *Chenopodium* oder einen *Rumex* erinnert. Von Kryptogamen wurde ein Zweigstück eines Lebermosses und durchaus unverkennbare Reste einer flächenhaft wachsenden Alge, *Prasiola*, gefunden. Auffällig an diesen *Prasiola*-Resten ist der Gehalt ihrer Zellen an noch grünem Chlorophyll; im Dunkel der staubtrockenen Höhle kan die *Prasiola* nicht gewachsen sein; vielleicht schützte der glatte Algenschleim das Chlorophyll vor den verdauenden Säften und förderte die Stücke schnell durch den Darmtraktus, von dessen Schleimhaut uns häufig Fetzen in mikroskopischen Gesichtsfeld aufstossen."

Bolivia.—From the Pleistocene deposits exposed in the valley of the Rio de Tarija in southern Bolivia, a great collection of vertebrate remains has been secured. Material from this region has been described by Gervais and by Burmeister. Pertinent to the present discussion are the remarks of Erland Nordenskiöld (1901), who has examined the Tarija badlands:

"Mir erscheint es als das glaublichste, dass das Tarijathal ehemals in seinen engen Grenzen diese an Individuen und Arten so reiche Fauna beherbergt habe, dass das Klima aber trockener als jetzt gewesen sei, so dass die Landschaft steppenartig war mit einzelnen durch die blind endenden Bäche gebildeten Sümpfen. Steppen, wo der Guanaco, von dem man zahlreiche Knochen einer identischen oder nahestehenden Form findet, und wo die kleinhufigen Pferde geeignete Naturverhältnisse für sich fanden, und einzelne Trümpel wo *Hydrochoerus cabibara* und *Myopotamus copyus* leben konnten. Man findet nähmlich Knochen von diesen beiden letzten sehr nahestehenden Formen.

"Dass die Riesenthiere, von denen die wichtigsten hier gefundenen *Mastodon andium, Megatherium americanum* und *Scelidotherium capellini-tarijensis?, Glyptodon clavipes, Lestodon armatus, Mylodon robustus* und *Macrauchenia patagonica* sind, gerade in solchem steppenartigen Boden günstige Lebensverhältnizze getroffen hätten, ist nach dem, was wir über die gegenwärtige Verbeitung der grossen Säugetiere wissen, sehr wahrscheinlich."

Another occurrence of Pleistocene mammalian remains in Bolivia, of considerable importance, is that near Ulloma. The fauna includes not only *Mylodon*(?), but *Scelidotherium* and *Megatherium*, species of *Hippidium, Onohippidium, Mac-*

rauchenia, and a mastodon. In commenting on the habitat of *Mastodon bolivianus*, a member of this assemblage, Pompeckj,[a] states as follows:

"Ob die Vegetation damals aber eine ganz wesentlich andere gewesen sein muss als heute, darf dahingestellt bleiben. Gerade in der Gegend des Rio Desaguadero und Mauri ist die Vegetation heute gar nicht so spärlich. Weite Strecken sind ziemlich dicht bestanden mit Büschen der *Baccharis tola*. Hier und in dem grasreicheren Desaguaderotal finden sehr sattliche Herden von Llamas reichliche Nahrung. Die *Hippidionarten* und *Macrauchenia* brauchten wohl kaum eine sehr viel reichlichere Vegetation als die heute dort lebenden Llamas. *Mastodon bolivianus* pflügte mit seinen Oberkieferstosszähnen den Boden auf und hat wohl in Gräsern und Sträuchern seine Nahrung gefunden, ohne reichlicheren Baumwuchses zu bedürfen. Dass die schwerfalligeren Megatherien und Scelidotherien auf reichen Baumwuchs angewiesen waren, das anzunehmen sind wir nicht gezwungen, da die heute lebenden *Xenarthra* ja keineswegs ausgesprochene Pflanzenfresser sind.

"Zur Diluvialzeit, oder wenigstens während des Abschnittes derselben, als die Fauna mit *Mastodon bolivianus* existierte, hat die bolivianische Hochebene in der Höhe von ca. 3800–4000 m wahrscheinlich den Charakter einer Steppe getragen, ähnlich wie heute, aber reicher an Niederschlägen und darum wohl auch reicher an Graswuchs und an Sträuchern als heute."

Ecuador.—An interesting occurrence of Pleistocene vertebrates at Punin, near Riobamba, was described a number of years ago by W. Reiss and the fauna was discussed by Branco.[b] This region lies in one of the intermontane valleys of the Cordilleras of Ecuador, between 1° and 2° 5′ south latitude, at an elevation of 2,600 to 2,800 meters. Reiss believed that the tuff which forms the deposit in this valley was erupted during the Pleistocene and that the volcanic activity extended into Recent time. Reiss was also of the opinion that the topographic and climatic features of the region during the Pleistocene were largely comparable to those of the country today. Numerous vertebrate remains were secured from the Pleistocene tuffaceous beds, and the following forms were determined by Branco:

Mylodon sp.
Equus andium (A. Wagner) Branco.
Protauchenia reissii Branco.
Cervus, 3 sp.
Cervus *cf.* chilensis Gay.
Mastodon andium Cuvier.
Smilodon *cf.* neogaeus (Lund).

Peru.—One of the results of the Yale Expedition of 1912 was the discovery of early Pleistocene vertebrates at Ayusbamba, Peru. The fauna was secured from a lacustrine deposit exposed in the heart of the Peruvian Andes at an elevation of approximately 12,400 feet. The assemblage of mammals described by Eaton (1914) comprises the following forms:

Mylodon sp.
Parahipparion sp.
Llama sp.
Odocoileus brachyceros.
Dibelodon bolivianus (Philippi).

This ancient body of water, in whose deposits the above mammals were entombed, has been designated Lake Ayusbamba by H. E. Gregory.[c] The origin and character of the lake are described by that author as follows:

"From the sections and descriptions given above it is evident that we are dealing with deposits which in part are truly lacustrine, material laid down in a body of quiet water which existed for a relatively long period of time. On the assumption that each layer of sand and of clay represents the amount deposited during a

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[a] J. F. Pompeckj. Mastodon-Reste aus dem interandinen Hochland von Bolivia. Palaeontographica, vol. 52, pp. 17–56, plates 3 and 4, 1905.

[b] W. Branco. Über eine fossile Säugethier-Fauna von Punin bei Riobamba in Ecuador. Palae. Abhandl., Bd. 1, Hft. 2, pp. 39–204, plates 6–24, 1883.

[c] H. E. Gregory. Geologic reconnaissance of the Ayusbamba (Peru) fossil beds. Amer. Jour. Sci., vol. 37, pp. 125–140, 1914.

single rainy season, approximately 100,000 years would be required for the accumulation of the materials exposed in the present fragmentary sections. It is probable that the lake beds had greater thickness. That they formerly extended much farther northward is shown by an unprotected, truncated section including 185 feet of strata perched high on the valley side overlooking the Chipura River. The containing wall of rock is complete except on the north side, where it has been entirely removed. Unlike the remaining portions of the rim, the north wall probably consisted of fluvial and glacial débris washed from the highlands. Moraines extend to the edge of the present lake deposits and may have formed the original barrier. During the life of the lake, fans from the high ridge at the south encroached upon its waters and separated the original sheet into more or less detached bogs. This process, combined with the development of a channel through the unconsolidated northern barrier, led to the extinction of the water body. Judging from the physical data at hand, this mountain tarn may have beautified the landscape of the late Pliocene or any portion of the early Pleistocene epoch—a conclusion which is in harmony with the palaeontological evidence."

As indicated above in the present discussion, the mylodont ground-sloths of North America apparently dwelt in surroundings similar to those in which the animals lived in South America, but their mammalian associates in the northern region during the Pleistocene were quite different from those found with the forms in the southern continent prior to Pleistocene time.

OCCURRENCE OF GROUND-SLOTHS AT RANCHO LA BREA.

Table 5 is a list of the Pleistocene mammalian fauna found at Rancho La Brea:

TABLE 5.

Insectivora.
Chiroptera.
Carnivora.
- Arctotherium californicum Merriam.
- Ursus sp.
- Aenocyon dirus (Leidy).
- Aenocyon milleri (Merriam).
- Canis occidentalis furlongi Merriam.
- Canis ochropus orcutti Merriam.
- Canis andersoni Merriam.
- Urocyon californicus Mearns.
- Taxidea, possibly n. sp.
- Mephitis occidentalis, n. subsp.?
- Spilogale sp.
- Mustela sp.
- Smilodon californicus Bovard.
- Felis atrox bebbi Merriam.
- Felis daggetti Merriam.
- Lynx, near rufus californicus Mearns.

Edentata.
- Mylodon harlani Owen.
- Mylodon harlani tenuiceps Stock.
- Megalonyx jeffersonii californicus Stock.
- Nothrotherium shastense Sinclair.

Artiodactyla.
- Camelops hesternus (Leidy).
- Capromeryx minor Taylor.
- ?Antilocapra americana (Ord)
- Odocoileus sp.
- Bison antiquus Leidy.
- Platygonus, possibly n. sp. or n. subsp.

Perissodactyla.
- Equus occidentalis Leidy.
- ??Tapirus sp.

Proboscidea.
- Mammut americanum (Kerr)?
- Elephas imperator Leidy?

Lagomorphs and many rodents.

An interesting feature of the deposits at Rancho La Brea, and one which does not readily submit to a satisfactory explanation, is that which centers in the occurrence of Pleistocene mammals in the various pits excavated by the Los Angeles Museum of History, Science, and Art and by the University of California. The ground-sloths forming an important element in the Pleistocene assemblage occurring in the asphalt deposits possess their full share of this peculiarity. Of the 96 pits sunk by the Los Angeles Museum at Rancho La Brea, only 30 were productive of osseous material in sufficient quantity to encourage pursuit of excavating work for any length of time.

As recorded in the field-notes of Mr. L. E. Wyman, in charge of the excavations at Rancho La Brea for the museum, ground-sloth remains were secured in approximately 19 of these excavations. Only a relatively small number of the remaining pits yielded Pleistocene bones to the apparent exclusion of edentate remains, while in a number only Recent forms were found. Pit 10, conspicuous in the

annals of the Rancho La Brea investigations because of the presence of remains of man, yielded in addition a large number of Recent types and only the extinct *Teratornis* of the truly Pleistocene assemblage. During the excavations conducted by the museum, the largest amount of material belonging to the genus *Mylodon* was secured from pits 3, 4, 13, 60, 61, 67, and 77 (see fig. 3). An estimation of the number of individuals preserved in these pits collected by the museum may be reached by a survey of the series of skeletal elements belonging to this animal. Results of this survey indicate the presence of at least 55 individuals of *Mylodon* in the collections of the Museum.

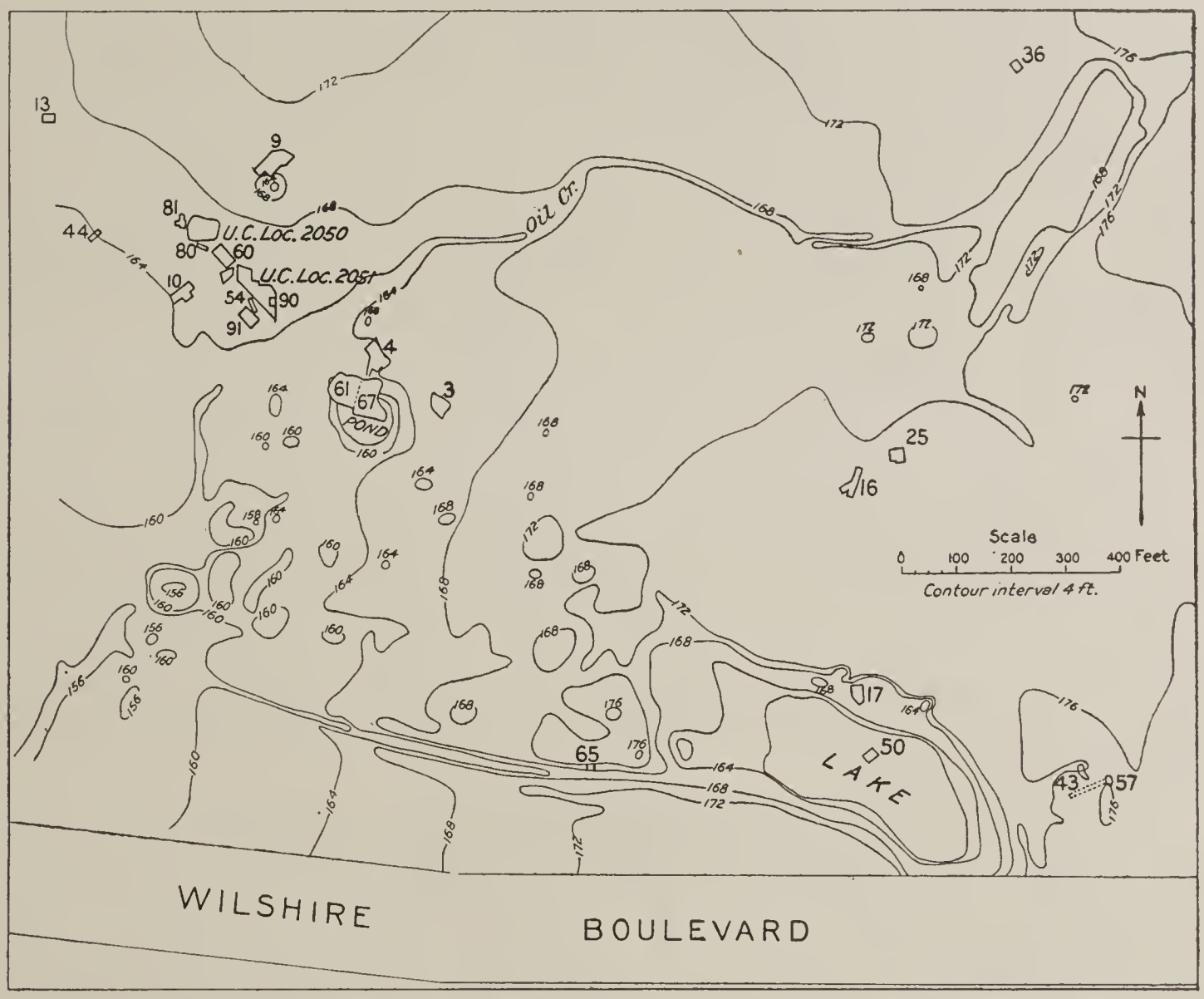


FIG. 3.—Topographic map of Rancho La Brea showing location of principal excavations of the University of California and Los Angeles Museum.

Prior to the excavations by the Los Angeles Museum, the University of California obtained a smaller collection of vertebrate remains from the asphalt deposits, principally at localities 2050 and 2051, the latter afterwards representing pits 1 and 2 of the museum catalogue. At the university diggings not less than 23 individuals of the genus *Mylodon* are represented.

The genus *Mylodon* may then be considered as a form occurring always with the Pleistocene assemblage at Rancho La Brea whenever this is typically represented. Such an assemblage would include *Aenocyon, Canis, Smilodon, Bison, Equus,* and *Camelops,* and undoubtedly a number of other large and small forms

of mammalia. The true concept of what this faunal complex was like will be obtained only when the last word concerning Rancho La Brea has been written. It is pertinent to any faunal study involving types occurring in the asphalt beds to ascertain whether or not a fundamental or basal faunal complex can be recognized in these deposits, and which in turn would reflect the type of environment present in the vicinity of Rancho La Brea during the period of accumulation of materials. It is of great importance also in any attempt to correlate this fauna with other Pleistocene assemblages living under conditions of environment essentially different from those prevailing at the asphalt beds.

Considering only the ground-sloth group, the recognition of a faunal substratum would materially aid in explaining the infrequent occurrence of the genera *Megalonyx* and *Nothrotherium* as contrasted with that of *Mylodon*. In the subfamily Megalonychinae the genus *Nothrotherium* is by far better represented in the pits than is *Megalonyx*—both genera occurring always in association with remains of *Mylodon*. No less than 12 examples of *Nothrotherium* are known and were obtained in pits 3, 4, 61, 67, 77, and 91. The nearly complete skeleton of *Nothrotherium* was exhumed in pit 3. During the first examination of the asphalt deposits in 1905, Professor Merriam recovered a tooth of this ground-sloth, now in the collections of the Museum of Paleontology, University of California. The specimen was found close to the surface in thoroughly indurated asphaltic material that apparently had been discarded during the early mining operations for asphaltum.

If the excavations of the museum are considered for the moment alone, it will be noted that in comparison to the ground-sloth *Mylodon*, which is represented in 19 pits, *Nothrotherium* occurs in only 5 or at most 6 pits and is particularly well represented in 1 (pit 67).[a] The evidence seems to indicate that *Nothrotherium* was not an habitual resident of the region about the petroleum pools, as was *Mylodon*, and the record of its sporadic occurrence is perhaps best interpreted if the form is considered as a visitant.

In a consideration of the remaining member of the Megalonychinae known to be present at Rancho La Brea—namely, the genus *Megalonyx*—an occurrence similar to that of *Nothrotherium* is noted, with, however, the added peculiarity that it is present in fewer numbers than the latter form. This fact is even more striking when we recall the extensive geographic distribution of *Megalonyx* in North America during the Pleistocene and its restriction to that continent as contrasted with *Nothrotherium*. At Rancho La Brea the genus is represented by comparatively little material. During the first excavations conducted by university parties, some material referred to this form was obtained, which included structures of the feet. Later, the university secured at locality 2051 additional remains consisting of a well-preserved lower jaw, elements of the anterior and posterior extremities, and of the manus and pes, and indicating perhaps the presence of not more than one or two individuals. Curiously enough, the remains of *Megalonyx* secured by

[a] It should be noted, however, that as the excavations progressed in the field it was found that pits 61 and 67, which originally were opened in close proximity, later developed into one and the same pit. It is possible that during the period of active trapping of these animals in the tar both pits were open at the surface in the form of pools, either separated or connected, and had their origin in the same underground phenomena which resulted ordinarily in the formation of such pools.

the Los Angeles Museum of History, Science, and Art are far fewer than those obtained by the university, notwithstanding the fact that the excavations were conducted on a much more extensive scale. In the museum collections there is a fourth metatarsal and a patella from pit 3, a peculiar tooth which has considerable resemblance to *Megalonyx dissimilis*, and several phalanges belonging probably to the same individual or individuals secured by the University of California from locality 2051. Thus, from the known materials not more than 4 or 5 individuals of *Megalonyx* can be estimated as occurring at Rancho La Brea.

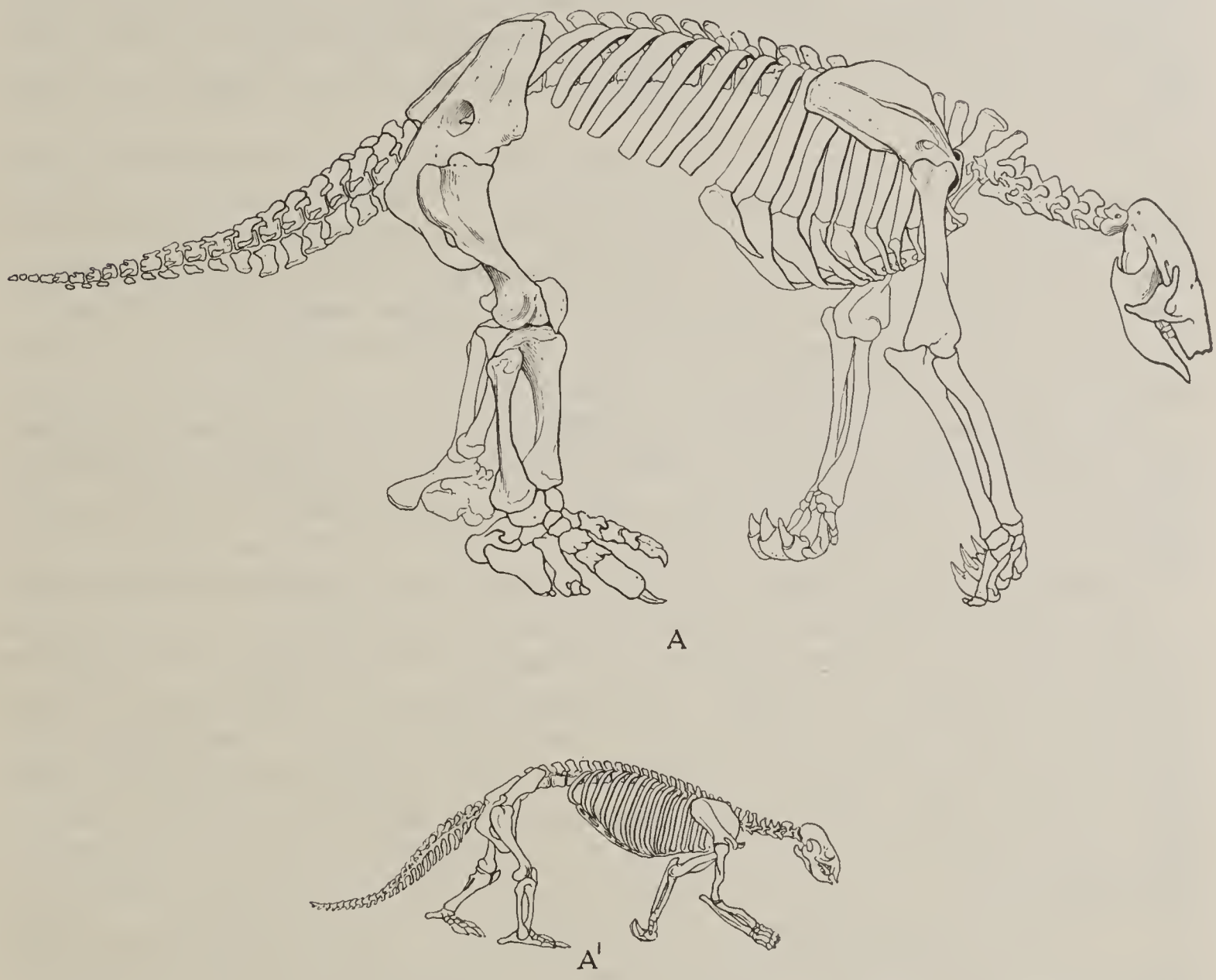


FIG. 4.—A, *Nothrotherium shastense* Sinclair. A^1, *Hapalops* sp. Skeletons shown in lateral view and to same scale. A^1, after Matthew.

PROBABLE APPEARANCE, HABITS, AND SOME FACTORS CONDITIONING THE LIFE OF THE RANCHO LA BREA GROUND-SLOTHS.

Nothrotherium is smaller than *Mylodon*, but is distinctly larger than the great ant-eater *Myrmecophaga*. Compared with nearly related forms, *Nothrotherium* is seen to be as large as some contemporary species of *Megalonyx* of the Pleistocene and probably three times as large as the ancestral *Hapalops* of the Miocene (see fig. 4). *Nothrotherium* possesses a relatively small head, which tapers forward to the prehensile lips, and a rather long and flexible neck. A narrow skull and the

spout-like symphyseal region of the mandible seem to imply a long, narrow tongue capable of protrusion. *Nothrotherium* lacked the caniniform teeth, so prominent a feature in other ground-sloths. The cheek-teeth grew from persistent pulps and their crowns were usually worn into anterior and posterior transverse crests with intervening valleys. These teeth were of service in mincing vegetable food.

The anterior appendages are long, *Nothrotherium* in this character reminding one, to some extent, of the tree-sloths. The individual elements of the limbs are more lightly constructed than in *Mylodon*, and this is true also when comparison is made with *Megalonyx*. The hand with its three claw-bearing digits found use in serving the head and in defense. The curiously flattened claw of the second digit, in contrast to those of the remaining fingers, indicates perhaps some special function.

While the pelvic girdle is fairly broad, *Nothrotherium* was not so heavily constructed posteriorly as *Mylodon*. The elements of the hind-leg are more slender than those in the latter genus and the fore-leg in proportion to the thigh was longer in *Nothrotherium*. The peculiar posterior foot in this ground-sloth seems to indicate that the animal was incapable of prolonged walking on the ground. The hind foot was less adapted to this purpose than that in *Mylodon* and certainly less so than that in either *Hapalops* or *Myrmecophaga*.

Nothrotherium (see frontispiece) probably had a heavy coat of hair, as is commonly found among the pilosic Xenarthra, but we can not of course be certain of the exact nature of the external covering. While the animal probably defended itself chiefly by use of the anterior extremities, there appears to be good reason for believing that it carried no protective armor of ossicles within the skin, as did *Mylodon*.

The characters thus indicated for *Nothrotherium* are interpreted as suggesting an animal living almost habitually in the dense jungles and forests or in regions having a heavy stand of timber. In this environment the animal availed itself not only of fronds, herbs, mosses, nuts, fruits, and berries, but clambering at the base of trees it would feed also on the foliage of the lower branches within reach. In such surroundings the ground-sloth was perhaps safe from the attacks of the larger carnivores frequenting the plains, as the saber-toothed tiger, the great lion, and the dire wolves. Excessive drought, glaciation with a lowering of the snow-line in the mountainous regions or the presence of other unfavorable conditions may have driven *Nothrotherium* occasionally from its natural habitat, forcing the animal to compete at a disadvantage with other mammals in a new and temporary environment. The occurrence of the ground-sloth at Rancho La Brea suggests that it did not live habitually in the immediate vicinity of the petroleum pools.

Megalonyx is unfortunately not well enough represented by materials in the Rancho La Brea beds or in other Pleistocene deposits of western North America to permit a satisfactory restoration. The ground-sloth is undoubtedly related to *Nothrotherium*, but distinct structural differences, as well as resemblances, are noted when the two forms are compared. *Megalonyx* was more robust than *Nothrotherium*, in which character it makes some approach to *Mylodon*. The

similarities in structure that exist between *Megalonyx* and *Nothrotherium* presumably point to habits of life somewhat comparable to those of *Nothrotherium*.

In the Rancho La Brea mammalian assemblage, *Mylodon harlani*, as a quadrupedal form (plate 45), was much smaller than the mastodon, but, like the latter, possessed considerable bulk and weight. With ponderous structure and perhaps an inherent trait of lethargic movement, *Mylodon* typifies an animal which should be regarded as the antithesis of a fleet-footed ungulate. *Mylodon* frequented the plains or dwelt at least in open stretches of flat or rolling country and occasionally ranged into elevated and perhaps more rugged regions. On the plains it may have resembled the rhinoceros in being more dependent on the olfactory sense than on keenness of sight in the recognition of approaching danger. *Mylodon* was well represented during the Pleistocene in the region of Rancho La Brea, where its associates among the large mammals were the horse (*Equus occidentalis*), the bison (*Bison antiquus*), the camel (*Camelops hesternus*), and members of the Proboscidea. Its most formidable enemies among the carnivores of the Rancho La Brea mammalian fauna were the saber-toothed tiger (*Smilodon californicus*), the great lion (*Felis atrox*), and the packs of dire wolves (*Aenocyon dirus*). In this assemblage the saber-toothed tiger, one of the most ferocious of the predatory beasts evolved during the later Cenozoic, and remarkably adjusted in structural characters to an association with the thick-skinned, slow-moving mammals of the North American Tertiary, may have found in the ground-sloths an added if not an easier prey. Counteracting the offensive warfare waged by the Carnivora were several characters in *Mylodon* of considerable importance. The strongly built chest and the powerful anterior limbs suggest great crushing strength. The latter character and the large claws of the hand were undoubtedly of great service to *Mylodon* in combating the attacks of its enemies. We note here a defensive struggle comparable to that which the great ant-eater and tree-sloths engage in with their enemies to-day. *Mylodon* was also protected against the deadly stabs of the truculent saber-tooth by the thick skin with heavy coat of coarse hair, and particularly by a dermal armor of pebble bones. The great tenacity of life exhibited presumably by the ground-sloths, even when severely injured, and still a notable feature of the tree-sloths and ant-eaters of South America, was undoubtedly of considerable benefit to these animals in the struggle for existence.

Mylodon may have wandered in small herds, feeding largely on grasses, shrubbery, fruit, berries, roots, and herbs. The short, thick neck with rather closely interlocking vertebrae did not possess much range of movement. The shortness of the neck was compensated by the long skull. The head terminated rather bluntly in front with thick broad lips that were somewhat prehensile. *Mylodon*, in lacking incisor teeth, probably did not graze by shearing the blades of grass after the manner of ungulates, but often tore the plants from the ground. The caniniform teeth may have been used in gnawing roots and the bark of trees, but the rather weak construction of these teeth and their frequent absence in the upper jaw suggest that they were not efficient structures in this service. These teeth may have found more adequate employment in cutting small branches or

twigs as the animal browsed. The relatively long jaws and the lobate teeth growing from persistent pulps gave a fairly good grinding battery.

In *Mylodon*, not only are the anterior limbs heavy, but the femur is particularly massive, while the tibia shows the characteristic shortening found in animals of slow movement. The writer can not agree with the suggestion made by Abel, that *Mylodon* may have been bipedal. It is true that in this genus the pelvis is large, with ilia greatly expanded. This type of pelvis is essential, however, for the support of the heavy viscera as well as for the attachment of powerful muscles controlling the movements of the femur. *Mylodon*, in resting, may have sat on its haunches, after the manner of bears.

The presence of a well-formed clavicle not only facilitates the use of the anterior appendages in serving the head and in permitting the arms and hands to act better as defensive organs, but the element was retained perhaps as a result of the slow movement of the quadruped. In walking the hands rested on the ends of digits 4 and 5, and we notice here a decided reduction in digital elements. The large claws carried by digits 3 and 2 may have been used also for digging.

As we have seen from the discussion of the habitat occupied by the ground-sloths, with which the present study is particularly concerned, *Nothrotherium*, *Megalonyx*, and *Mylodon* were not subjected always to similar environmental conditions. The differences in habitat noted between the megalonychid and mylodont ground-sloths tend to strengthen the interpretation of the structural characters possessed by these forms.

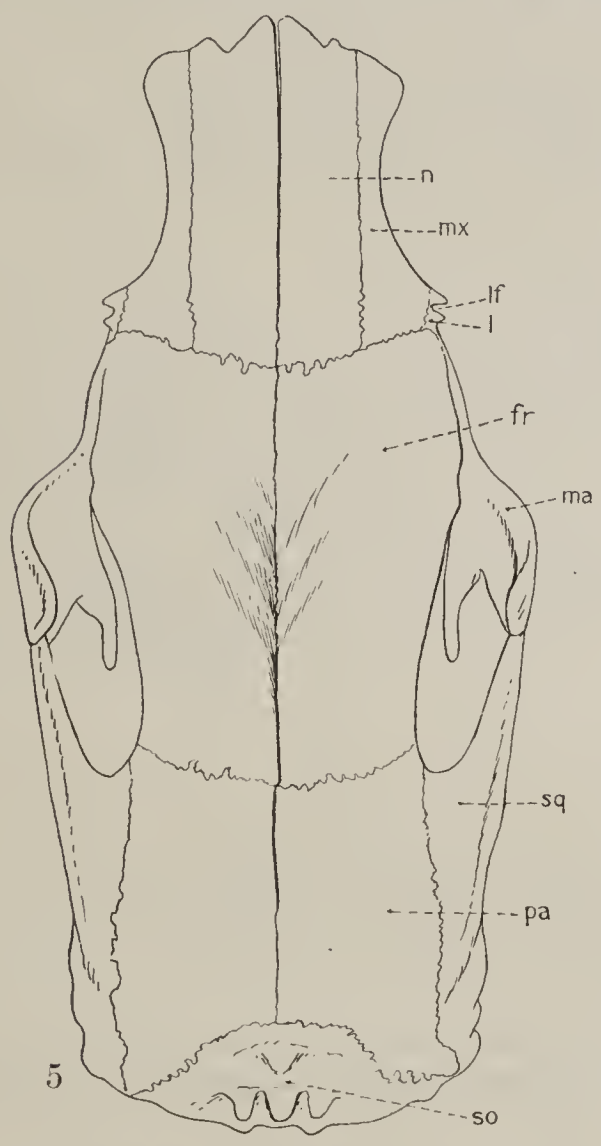
CLASSIFICATION AND RELATIONSHIP OF THE GRAVIGRADE EDENTATES OF RANCHO LA BREA.

A survey of the classification of the ground-sloths as made by previous authors indicates that there has not been uniformity of opinion regarding the systematic position of these mammals. Under the group of gravigrade edentates several divisions have been recognized, having either subfamily or family rank. For example, Zittel divides the Gravigrada into three subfamilies, namely, (1) Megatheriinae, (2) Megalonychinae, and (3) Mylodontinae. Under the Megatheriinae, Zittel lists, among other forms, the large *Megatherium* and the genus *Nothrotherium*. Zittel also regards the Planopsinae, a group recognized originally by Scott as of family rank, as ancestral to the Megatheriinae. In the subfamily Megalonychinae are placed such genera as the Pleistocene *Megalonyx* and the Miocene *Hapalops*, *Eucholoeops*, *Megalonychotherium*, and other forms from the Santa Cruz beds. In the Mylodontinae are included *Mylodon* and related genera.

Scott (1903–4), in the report on the edentates from the Santa Cruz deposits, regarded the genus *Planops* as rather closely related to the megatheres, but sufficiently distinct to be given recognition with other forms under a family, namely, the Planopsidae. In a later work, however, Scott (1913) has simplified the classification of the Gravigrada and lists but three families, namely, the Megatheriidae, Megalonychidae, and the Mylodontidae.

The present study of the gravigrade edentates has convinced the writer that a somewhat different grouping of the forms should be made. It appears evident that the members of the Megatheriidae and the Megalonychidae stand closely related in Miocene time and that their common ancestry was not distantly removed in time from this period. This seems to be clearly indicated in the fundamental structures of the skull

and dentition of the types as represented by the specimens from the Santa Cruz beds of Patagonia. In both forms the dentition in the cheek region consists of teeth that are nonlobate. In the Pleistocene megatheres and megalonychids these teeth become quadrate or semi-quadrate in cross-section. The last lower tooth in the Miocene planopsids and megalonychids exhibits also the peculiarity of having the principal transverse axis oblique to the antero-posterior axis of the jaw. While the Pleistocene *Megatherium* exhibits a last lower tooth similar in general shape and in position to the anterior cheek-teeth, the corresponding tooth in *Megalonyx* and in *Nothrotherium* differs in shape from the anterior teeth and retains the obliquity of its transverse axis. Moreover, the Miocene planopsids and megalonychids are both characterized by the presence of caniniform teeth anterior to the cheek-teeth. These teeth are lost in *Megatherium* and in *Nothrotherium*, but are very prominent in *Megalonyx*.



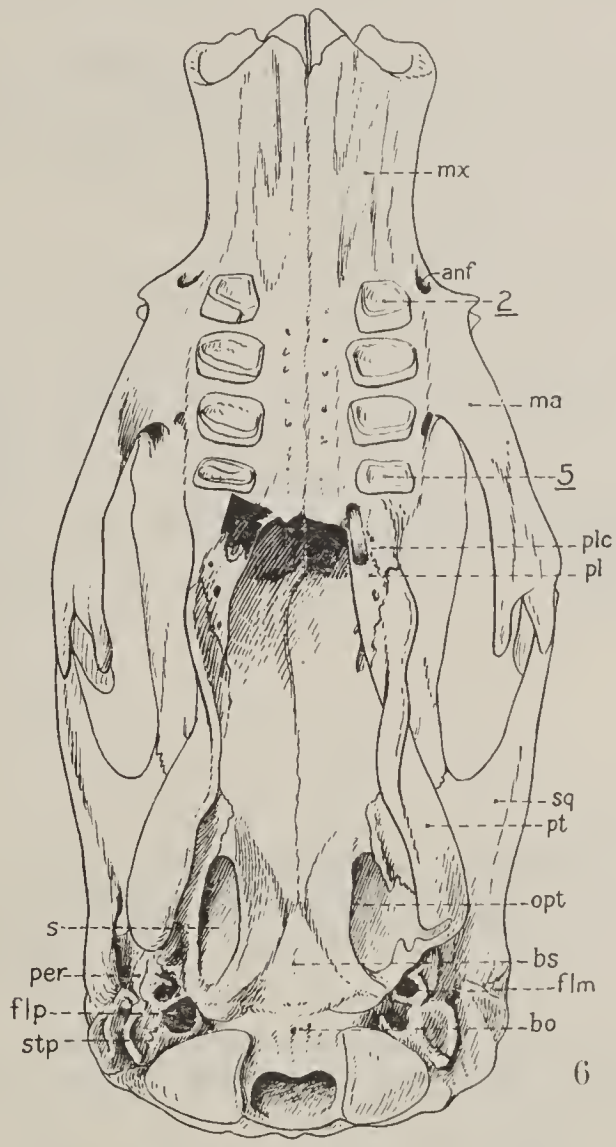


FIG. 5.—*Nothrotherium shastense* Sinclair. Skull, dorsal view. × 0.33. *n*, nasal; *mx*, maxillary; *l*, lachrymal; *lf*, lachrymal foramen; *fr*, frontal; *ma*, malar; *sq*, squamosal; *pa*, parietal; *so*, supra-occipital. Rancho La Brea Pleistocene.

FIG. 6.—*Nothrotherium shastense* Sinclair. Skull, ventral view. × 0.33. *mx*, maxillary; *anf*, antorbital foramen; *ma*, malar; *pl*, palatine; *plc*, palatine canal; *sq*, squamosal; *pt*, pterygoid; *s*, pterygoid sinus; *opt*, orifice of pterygoid sinus; *per*, periotie; *bs*, basisphenoid; *bo*, basioccipital; *flm*, foramen laeerum medium; *flp*, foramen lacerum posterius; *stp*, stylohyal proeess; 2, 5, second and fifth superior teeth. Rancho La Brea Pleistocene.

From the above considerations it would appear that the differences in the dentition between the megatheres and the megalonychid ground-sloths are not of sufficient importance to merit the recognition of the groups as distinct families. Likewise, such differences as may appear in the structure of the skull and skeleton, particularly in the Pleistocene forms, may be in part due to a difference in size and not necessarily indicative of a distant relationship. The writer would, therefore, group all these forms under the Megatheriidae, recognizing within this family the two subfamilies, Megatheriinae and Megalonychinae.

Standing in decided contrast to the Megatheriidae is the great division of mylodont ground-sloths, including such forms as *Mylodon*, *Scelidotherium*, *Nematherium*, and others. Because of distinctive characters in the dentition, skull, and skeleton, this group is regarded of family rank, for which the name Mylodontidae should be retained.

The mylodont ground-sloths are not only distinguished by teeth that are lobate, but the later types are known definitely to have carried in their skin a dermal armor of pebble-like bones. In these two characters the Mylodontidae differ from the Megatheriidae and are to be compared rather with the Glyptodontidae. The Pleistocene glyptodonts are characterized by a peculiar type of teeth, from which the group derives its name. Among the glyptodonts of the Miocene, forms are present in which the trilobed teeth were not distributed throughout the length of the jaws, but the anterior teeth were of more simple pattern. An interesting comparison can be made between the anterior teeth of *Eunicepeltus* and the teeth present in *Mylodon*. The last lower tooth in *Mylodon* exhibits particularly some characters strikingly similar to those in the trilobed teeth of the glyptodonts. On the other hand, it is recognized that a comparison between the Miocene mylodonts and glyptodonts would be more appropriate.

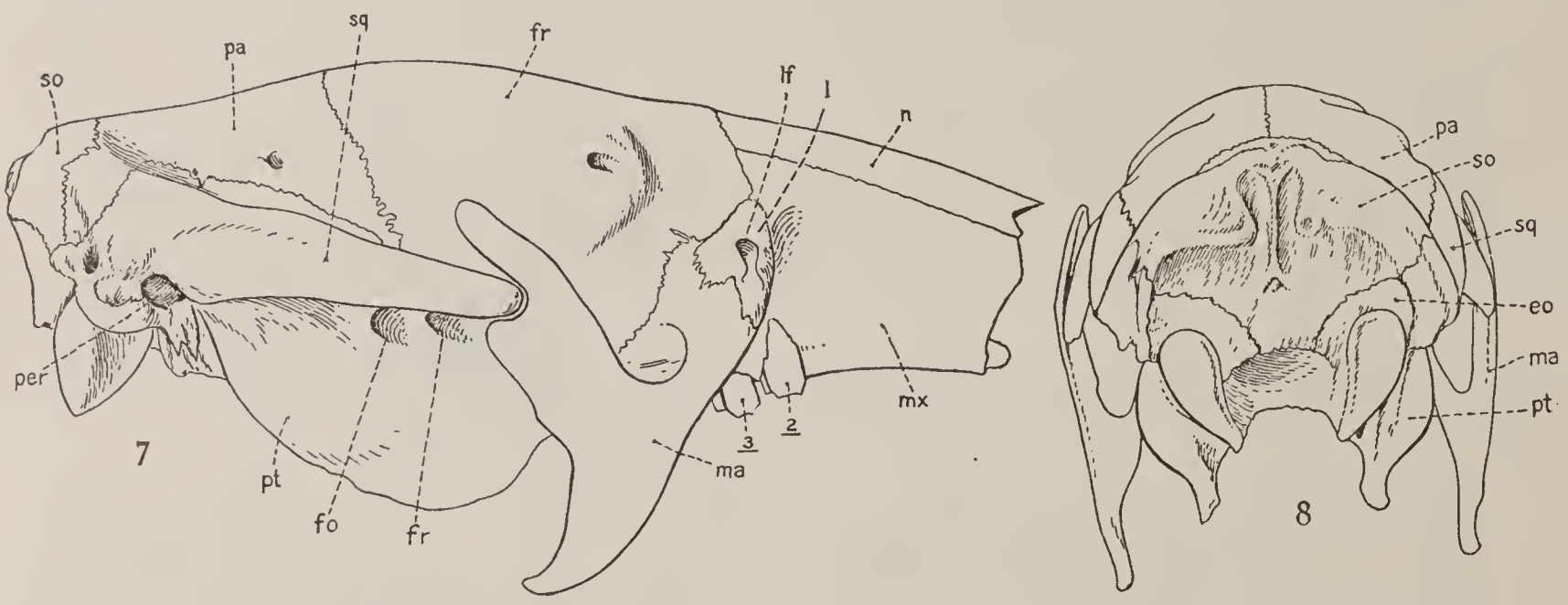


Fig. 7.—*Nothrotherium shastense* Sinclair. Skull, lateral view. × 0.33. 3, third superior tooth; *fr*, foramen rotundum; *fo*, foramen ovale; remaining letters as in other figures. Rancho La Brea Pleistocene.

Fig. 8.—*Nothrotherium shastense* Sinclair. Skull, posterior view. ×0.33. Letters as in other figures. Rancho La Brea Pleistocene.

Unfortunately, the former group is not known by much material from the Santa Cruz beds. Concerning the dentition in the Miocene Mylodontidae, Scott (1904, p. 345) has remarked as follows:

> "The family is most distinctively characterized by the teeth, which in the upper jaw are triangular, and in the lower jaw lozenge-shaped, while the last lower tooth is bilobate; the valleys are central and are usually enclosed in a continuous wall of the harder dentine."

In such a genus as *Nematherium* the dentition shows no greater similarity to the anterior teeth of the Miocene glyptodonts than does that of *Mylodon*. As a matter of fact, in this form the last lower tooth has a more simple pattern than in the Pleistocene *Mylodon*. Nevertheless, the lobate character is already defined and, in view of the very scant material available of these Tertiary forms, still furnishes a basis for comparison with the glyptodont types.

We might conceive of the Mylodontidae as arising from an early stock of glyptodonts or nearly related forms in which simple lobate teeth were present throughout, or nearly throughout, the length of the jaws. Such armor as may have been present in the earliest

forms was subsequently reduced until in the Miocene and later types only rudimentary dermal bones remain. It is possible also that in the earliest mylodonts the exoskeleton was already rudimentary. It would be interesting to compare the Mylodontidae and the Glyptodontidae of the South American Oligocene and Eocene were these groups known by complete types. Perhaps a detailed comparison of the later forms, with due allowance for changes in the skull and skeleton of the glyptodonts necessitated by the great development of the dermal armor, would yield data pertinent to the present discussion. The origin of the Mylodontidae must have antedated considerably the period of the Santa Cruz deposition.

The tree-sloths are more closely related to the Megatheriidae than to the Mylodontidae. The origin of the Tardigrada is still obscure, for, unfortunately, these forms are not known in the palaeontologic record of early or middle Tertiary time.

MEGALONYCHINAE OF RANCHO LA BREA.

CHARACTERS OF SUBFAMILY MEGALONYCHINAE.

Hairy ground-sloths with apparently no dermal ossicles. Skull elongate and cylindrical (*Hapalops* and *Nothrotherium*), or short, broad, and deep (*Megalonyx*); premaxillaries reduced. Neck and trunk more elongate than in Mylodontidae; lumbar vertebrae not ankylosed with sacral series. Dentition $\frac{5-4}{4-3}, \frac{5-4}{4-3}$. First tooth, when present, is caniniform and in cross-section is round, oval, or meniscoid, with an inner bulge. First tooth separated by long diastema from cheek-teeth. Cheek-teeth oval or semi-quadrate in cross-section. Last upper tooth compressed antero-posteriorly; last lower tooth with principal transverse axis oblique to fore-and-aft axis of tooth-row. In Pleistocene forms last lower tooth with convex inner face and flattened outer face. Humerus with entepicondylar foramen; femur with third trochanter; pelvis with ilia not so expanded as in Mylodontidae. Claw-processes of ungual phalanges usually laterally compressed; largest ungual phalanx in digit III, pes.

CHARACTERS OF GENUS NOTHROTHERIUM.

Skull elongate and cylindrical; lachrymal prominent; malar vertically expanded with inferior process slender; frontal with large sinus; pterygoid usually with large posterior sinus opening inward. Lower jaw slender with spout-like predental region. Dentition $\frac{4}{3}, \frac{4}{3}$. Last superior tooth compressed antero-posteriorly and semi-quadrate in cross-section. Anterior caniniform teeth absent. Haemapophyses in middle part of tail are X-shaped. Scapula relatively small. Manus with metacarpals longer and more slender than in *Megalonyx;* pollex reduced and digit V rudimentary. Ungual phalanx of digit II, manus, broad with convex dorsal surface. Wing-like posterior process of calcaneum longer, but not as broad as in *Megalonyx*. Astragalus resembles that of *Mylodon* and is more specialized than in *Hapalops* or in *Megalonyx* in adjustment to rotation of pes to a position of rest on outer side. Metatarsal IV larger than in *Megalonyx;* metatarsal V with lateral wing-like process. Hallux reduced; ungual phalanges in digits II and III; digits IV and V rudimentary in pes.

Genus NOTHROTHERIUM Lydekker.

Coelodon. P. W. Lund, Ann. Sci. Nat., ser. 2 (Zool.), vol. 11, p. 220, 1839.
Nothrotherium. R. Lydekker, Nicholson and Lydekker, Manual of Palaeontology, ed. 3, vol. 2, p. 1299, 1889.
Hypocoelus. F. Ameghino, Rev. Arg. Hist. Nat., vol. 1, p. 250, 1891.
Nothrotherium?. W. J. Sinclair, Univ. Calif. Publ., Bull. Dept. Geol., vol. 4, p. 153, 1905.
Nothrotherium. F. Ameghino, Rev. do Museu Paulista, vol. 7, p. 74, 1907.
Nothrotherium. C. Stock, Univ. Calif. Publ., Bull. Dept. Geol., vol. 7, p. 342, 1913.
Coelodon. H. Winge, E. Museo Lundii, vol. 3, pt. 2, p. 287, 1915.
Nothrotherium. O. P. Hay, Proc. U. S. Nat. Mus., vol. 51, p. 116, 1916.
Nothrotherium. C. Stock, Univ. Calif. Publ., Bull. Dept. Geol., vol. 10, p. 137, 1917.

Nothrotherium shastense Sinclair.

Nothrotherium graciliceps Stock, Univ. Calif. Publ., Bull. Dept. Geol., vol. 7, p. 342, 1913.
Nothrotherium shastense Sinclair, Univ. Calif. Publ., Bull. Dept. Geol., vol. 10, p. 137, 1917.

Description of Material.

CRANIUM.

The largest available skull (No. 1800–5)[a] of *Nothrotherium* from Rancho La Brea is approximately as long as a skull of *Megalonyx jeffersonii* described by Leidy (1855). With this exception the specimens from the asphalt beds are all somewhat shorter than either *M. jeffersonii* or *M. leidyi*. In marked contrast to *Megalonyx*, however, is the

Fig. 9.—*A*, *Nothrotherium shastense* Sinclair. A^1, *Hapalops longiceps* Scott. Skull and mandible, lateral view. × 0.33. A^1 adopted and reversed from Scott.

relative slenderness of skull in *Nothrotherium*. In this respect the latter genus more closely resembles the Miocene Megalonychinae and Megatheriinae (Scott, 1903, p. 164, fig. 16) from which it has also deviated less than *Megalonyx* in general shape of skull. Contrasted with *Planops*, one of the largest of the Santa Cruz Gravigrada, the skull of the Pleistocene genus is distinctly larger.

[a] All numbers used in the following comparisons in this paper, unless otherwise stated, are the catalogue numbers of specimens in the Los Angeles Museum of History, Science, and Art.

Nothrotherium differs from *Megalonyx* and agrees with *Hapalops* in the long and slender muzzle (plates 2 and 4, and fig. 9). In No. 1800–3, the anterior ends of the maxillaries are noticeably flared. This character is less apparent in No. 1800–6 and may be but little developed as in No. 1800–5. The nasals are long and may be more decidedly arched in some skulls than in others. In No. 1800–3 the fronto-nasal suture is convex posteriorly, thus resembling most species of *Hapalops*. This suture may, however, vary in *Nothrotherium*. It may be decidedly V-shaped as in No. 1800–6, but in this specimen the original suture appears to have been somewhat in advance of the present separation. In No. 1800–6 the nasals have apparently fused with the frontals, a secondary or pseudo fronto-nasal suture developing posterior to the original suture. A similar abnormality in the separation between nasal and frontal has been noted in skulls of *Mylodon harlani* from Rancho La Brea (Stock, 1914, p. 322).

In some specimens the lachrymal is not as prominent in superior view as in species of *Hapalops*, but its canal is very much in evidence. In *Megalonyx* the lachrymal and its canal are apparently not to be seen in dorsal aspect. The postorbital processes of the frontals may be very blunt in some specimens of *Nothrotherium*, thus being more as in *Megalonyx* and differing from *Megatherium*.

Just behind the postorbital process is a small depression, seen best in lateral view of skull (plate 4, fig. 1), at the posterior end of which lies the exit of a small canal. This canal extends backward and downward in the lateral wall of the frontal for a distance of approximately 45 mm., then turns inward and opens into the brain-case, the perforation being situated beyond the upper outer margin of the orifice through which the olfactory lobe extends. Between and slightly posterior to the supraorbital borders, the frontals sag in the middle line. This sag is perhaps most evident in the largest specimen, No. 1800–5, and in skull 1800–7. In skull 1800–13 it is practically absent.

The temporal ridges are but faintly marked in all specimens from Rancho La Brea, *Nothrotherium* thus resembling the Miocene Megalonychinae. At the coronal suture, where the crests approach each other most closely, the distance between them may vary. There is never a pronounced sagittal or lambdoidal crest present, as in *Megalonyx*. In front of the weak lambdoidal crest the dorso-lateral surface of the parietal may sag slightly. This sag is distinctly developed in 1800–6, where it reaches the median dorsal suture of the cranium, or it is hardly discernible, as in skulls 1800–3 and 1800–5. In all skulls of *Nothrotherium* the supraoccipital is more prominent in superior view than in *Megalonyx*.

The Brazilian species described by Reinhardt (1878) differs noticeably from the Californian form in dorsal contour of skull. It is possible that this difference is in part due to age, but it is probably a specific distinction. In *Hapalops longiceps* the frontal is more elevated than the parietal, while in *H. vulpiceps* and *H. gracilidens* the reverse is true, the parietal being much more highly vaulted than the frontal. In the elevation of the frontal the Rancho La Brea species of *Nothrotherium* approaches *Planops* most closely. *Megalonyx* differs from its Pleistocene contemporary in the straight dorsal contour of the skull.

The zygomatic process of the squamosal is long and slender. It is relatively longer than in *H. longiceps*. In skull 1800–13, used as the type in the first description (Stock, 1913) of the species from Rancho La Brea, this process is lacking. The malars have been preserved in several skulls, notably in No. 1800–11, where they are firmly attached at the base to lachrymal and maxillary. The malar resembles that in *Hapalops* in slenderness, and, as in the Miocene genus, is not fused with the zygomatic process of the squamosal. It differs from *H. longiceps* in (1) its relatively shorter antero-posterior extent, (2) an absence of a marked outward flare of the infraorbital border, (3) a shorter dorsal prong, but deeper notch for the zygomatic process of the squamosal, and (4) a relatively longer and more slender ventral prong.

In *Megalonyx* the zygomatic process of the squamosal is much heavier than in *Nothrotherium*. In *M. leidyi* (Lindahl, 1893) and in *Megatherium americanum* this process has completely fused with the malar. The postorbital border of the malar is decidedly more curved in *M. leidyi* than in *Nothrotherium*. The ventral prong is also relatively more slender at the base in *M. leidyi*.

The parietal sends downward and forward a narrow extension which usually meets the lateral portion of the alisphenoid. Occasionally this extension does not reach the alisphenoid, but is interrupted by the frontal. The foramen ovale and the foramen rotundum are separate and are of approximately equal size. In *Hapalops*, according to Scott, the exits for the second and third branches of the trigeminal nerve are combined. The anterior lacerate foramen is situated anterior to the foramen rotundum at a distance slightly greater than that between the foramen rotundum and the foramen ovale. The exit for the ophthalmic branch of the trigeminal nerve lies at the posterior end of a groove which widens anteriorly, and may be somewhat obscured by an overhanging ridge formed by the frontal. Posteriorly this ridge straightens and in some specimens forms

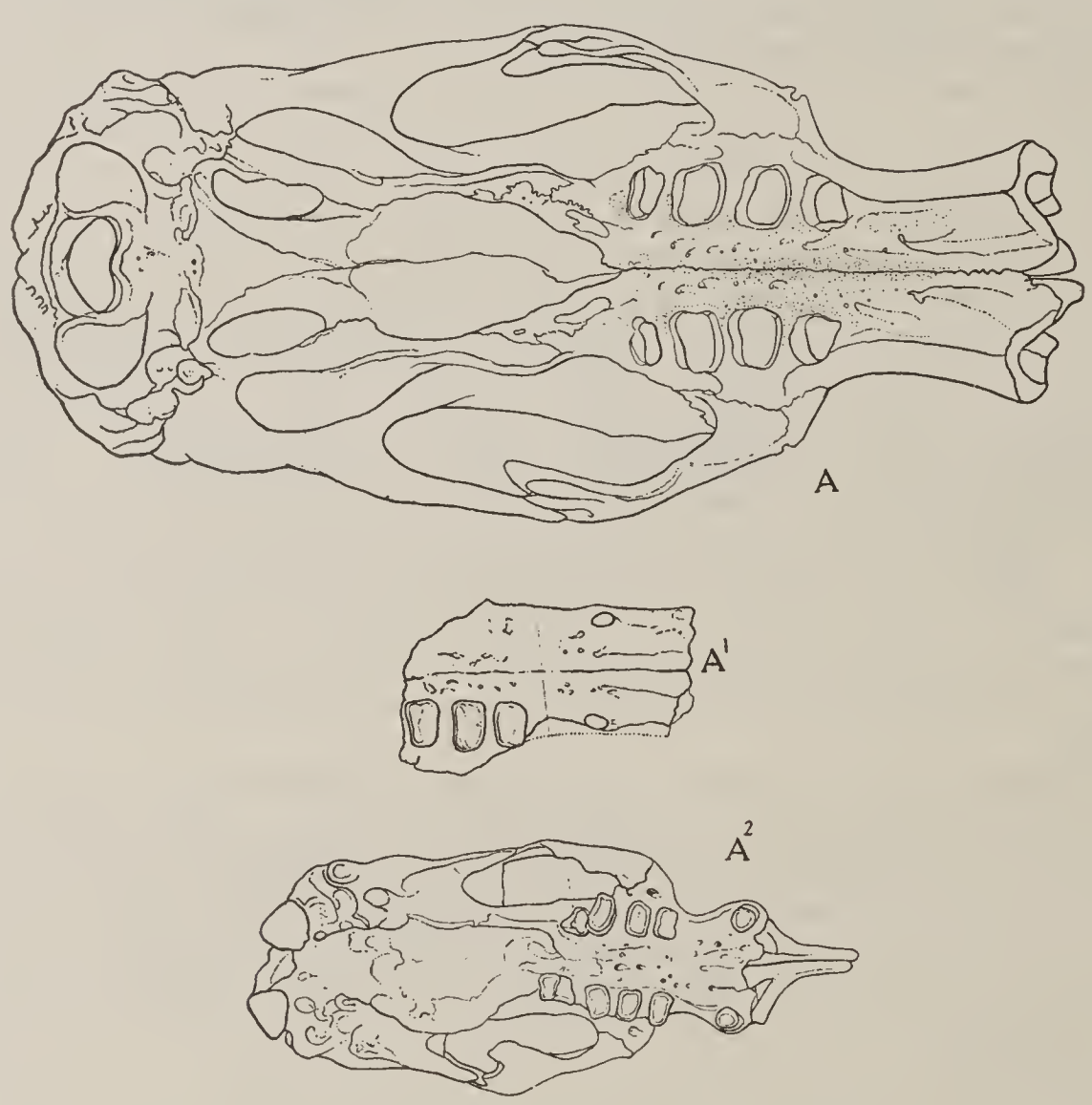


FIG. 10.—*A*, *Nothrotherium shastense* Sinclair. A^1, *Pronothrotherium typicum* Ameghino; A^2, *Hapalops longiceps* Scott. Ventral view of skull. A^1, after Rovereto; A^2, after Scott.

the division between frontal and alisphenoid to the anterior end of the squamosal. The optic nerve enters the orbit from this groove. It is not clear whether the second cranial nerve passes through the cranial wall in the canal occupied by the first branch of the trigeminal or whether it passes through a distinct canal. A small opening has been observed on the inner wall of the canal for the first branch of the fifth nerve close to the exit. The orbitosphenoid is partly defined by suture in some specimens.

The premaxillaries, although originally present in the Rancho La Brea skulls, have unfortunately not been found in the collections. Their articulating surfaces on the

maxillaries reveal some interesting peculiarities. On each side of the small median V-shaped notch the maxillary is thickened, especially the palatal portion. This thickening of the maxillary extends well up along the sides of the external narial opening, in some skulls reaching nearly halfway to the top of the orifice. In the Brazilian species described by Reinhardt, the premaxillary is shown as a Y-shaped element. In Reinhardt's figure (Reinhardt, 1878, plate 1, fig. 3) the median arm of the posterior end is seen to be short, while the lateral arm is longer and appears to curve upward. This apparently, corresponds with the thickening of the maxillary at the inferior external angle of the narial opening. The anterior arm of the premaxillary was presumably not very long in *Nothrotherium* from the asphalt beds.

In *Hapalops* a similar Y-shaped premaxillary is present. The articulation of this element with the maxillary may somewhat resemble that in the Rancho La Brea genus. The articulation between premaxillary and the end of the palatal part of the maxillary is not as extensive in *Nothrotherium* as in *Hyperleptus*. In the Miocene *Planops*, according to Scott (1904) "the premaxillae were evidently large, the facets for them upon the maxillaries being of uncommon size, while the median notch for the spines is a characteristically deep and narrow V." In *Megalonyx jeffersonii*, Leidy (1855) describes the premaxillaries as "simple, oblong, quadrilateral plates, a little more than two inches in depth, and three quarters of an inch in breadth."

Owing to the slenderness of the muzzle, the anterior aspect of the skull of *Nothrotherium* is very unlike that in *Megalonyx*. In *M. jeffersonii*, according to Leidy, "the end of the face is relatively narrower and higher than in *Mylodon;* and in outline is more vertically oblong quadrilateral, with the upper margin convex and the sides nearly vertical." In *Nothrotherium*, where the first or caniniform tooth is absent, the anterior end of the skull is nearly round or oval. The external narial opening is relatively wide transversely as contrasted with the height. The lateral walls show no indication of notching as in *Megatherium*. With the disappearance of the caniniform tooth in *Nothrotherium*, the depression of the lateral wall of the maxillary anterior to the first (2) upper cheek-tooth becomes nearly obsolete. This depression is better developed in *Hapalops* and is very pronounced in *Megalonyx*.

The palate (plate 2, fig. 2) anterior to the first upper cheek-tooth (2) may be approximately twice as wide as between the tooth-rows. The lateral borders of the edentulous portion of the palate may be nearly straight, as in No. 1800–3, or they may become convex outward, as in skull 1800–5. In the outwardly convex borders of the palate, No. 1800–5 resembles greatly species of *Hapalops* in which the first or caniniform tooth is some distance posterior to the end of the skull. In particular does it resemble a skull of *Planops longirostris* illustrated by Scott (1904, plate 59, fig. 1*a*). In *Megalonyx* the palate in front of the first upper tooth (2) is relatively shorter and the sides diverge anteriorly more than in *Nothrotherium*.

The palate is flat or somewhat convex. It is considerably pitted with large and small foramina, resembling *Hapalops* in this respect more than *Planops*. On either side of the raised median suture and between the tooth-rows extends a series of large foramina. From the most anterior of these, which occupy a position approximately at the middle of the predental portion of the palate, widening grooves extend forward to nearly the front end of the skull. Scott describes the edentulous space in *H. longiceps* as having "a well-defined groove on each external side, with raised outer border." In No. 1800–5 the anterior openings of the palatine canals lie between the points of greatest outward curvature of the margins of the palate. In skull 1800–2 they open on the surface of the palate much more posteriorly, or nearer the first upper cheek-tooth, than in the remaining skulls.

The palatine suture, which for some distance parallels the margin of the postpalatine notch, meets the middle line of the palate between or behind the posterior ends of the

third upper cheek-tooth. The postero-internal border of the alveolus for the fourth upper cheek-tooth (5) may be somewhat elevated, causing the palate to become transversely concave in this region. The posterior opening of the palatine canal opens at the anterior end of an elongate pit. The latter is situated on the palatine shelf bordering the postpalatine notch, and its anterior border is usually posterior to the last superior tooth. The pit may, however, extend well along the inner side of the fourth upper cheek-tooth (5). At the posterior end of the elongate pit a second opening leads to the lateral cranial wall. The large foramina, extending in a row on either side of the median suture of the palate, open directly into the palatine canals.

The postpalatine notch is always more acute than in the skull described by Reinhardt, and apparently reached slightly farther forward in the Rancho La Brea species. Its position is, however, well posterior to the fourth upper cheek-tooth. In *Planops magnus*, Scott (1904, p. 326) states that "the posterior nares do not extend so far forward as in most of the contemporary Gravigrada, the front margin being a little behind 5 . . ." The pterygoid plates continue backward from the shelf, formed by palatine and in part also by maxillary, along either side of the postpalatine notch. On these plates the inferior border is broadly rounded, while in *Megatherium* it is angulate. In the Rancho La Brea *Nothrotherium* the plates are very similar to those in Reinhardt's specimen, and posteriorly are seen to enlarge into great bullae, as in the latter form. These bullae differ from those shown by Reinhardt in being pierced along their inner ventral wall by a large and elongate orifice. Between the outer border of this opening and the inferior border of the pterygoid plate a broad groove extends from the outer posterior to the inner anterior side, diagonally across the inflated portion. The posterior border of the pterygoid may approach the occipital condyles very closely, thus differing decidedly from *Megalonyx*.

The inflated pterygoids are perfectly preserved in skull 1800–11 (plate 2, fig. 2), in which specimen they swell outward somewhat below the base of the zygoma and behind the glenoid fossa. They are much better preserved than in the skull No. 1800–13 originally described. The skull in the Brazilian species described by Reinhardt possesses also pterygoids that are inflated. In the Brazilian species, judging from the figures given by Reinhardt, the inflated pterygoids do not possess internally an orifice, as in the skulls of the Californian species. The pterygoid bullae in all skulls except one are large. In No. 1800–4, which is the smallest of the 8 nearly complete skulls contained in the Los Angeles Museum of History, Science, and Art, and evidently belongs to a somewhat younger individual, the posterior inflation of the pterygoid is exceedingly small and is restricted to the extreme posterior end of the pterygoid. The ventral opening of the bullae is also small. Between the cavity and the descending plate the pterygoid is thickened in this specimen.

In *Hapalops longiceps*, according to Scott (1903, p. 185), "the pterygoids are narrow, inconspicuous plates, closely applied to the descending processes of the alisphenoids, and not in the least like the swollen, bulla-like bones of *Nothrotherium*, which Reinhardt has described ('78, 336)." Structures comparable to the pterygoid bullae of *Nothrotherium* and occupying a similar position are absent in *Megalonyx*. Lindahl (1893, p. 7), however, records that in *M. leidyi* "capacious air sinuses extend backward in the root of the pterygoid (pl. III), and branch off from there forward into the alveolar wall of the maxilla." An extensive inflation of the pterygoid in skulls of the tree-sloths *Choloepus* and *Hemibradypus* have been noted by Anthony.[a] With reference to the air sinuses in the skull of the former genus, he states:

"Le sinus sphénoidal s'étend latéralement à l'intérieur des ptérygoides, se prolonge dans le temporal, envahissant la base de l'apophyse zygomatique et venant presque au contact des prolongements latéraux du sinus frontal. Le crâne osseux présente un orifice situé à la face interne et antérieure de chaque ptérygoide et qui conduit dans ce sinus."

[a] R. Anthony. Recherches anatomiques sur les bradypes arboricoles, etc. Ann. Sci. Nat. sér. 9 (Zool.), vol. 9, pp. 157–285, plates 2–6, 1909.

Nothrotherium therefore resembles *Choloepus* very closely, not only in the large size of the pterygoid inflation, but also in the presence of an orifice perforating the inner wall of the pterygoid.

The alisphenoid forms not only the roof of the pterygoid bulla, but the dorso-internal wall as well. In some skulls an internal continuation of the vacuity of the pterygoid extends toward the middle line. In skull 1800–5 this extension, lying above the ventral surface of the basisphenoid, is separated from its fellow of the opposite side by a median partition only 2 mm. in thickness.

The basisphenoid is concave transversely and tapers toward the anterior end, where the pterygoid bullae approach each other most closely.

The basioccipital in most skulls is short, relatively much more so than in *Megalonyx*. The tympanic, as seen in No. 1800–11, resembles *Hapalops* in the incomplete irregular circle of bone which incloses ventrally the large external auditory meatus. Anteriorly the tympanic may touch the dilated wall of the pterygoid. Posterior to the tympanic is the stylo-hyal process with its ovoid depression. It is situated much closer to the occipital condyle than in *Megalonyx*. The small condylar foramen lies in a pit and may be entirely hidden by the border of the occipital condyle. In *Hapalops*, and especially in *Megalonyx*, this foramen is well in front of the occipital condyle.

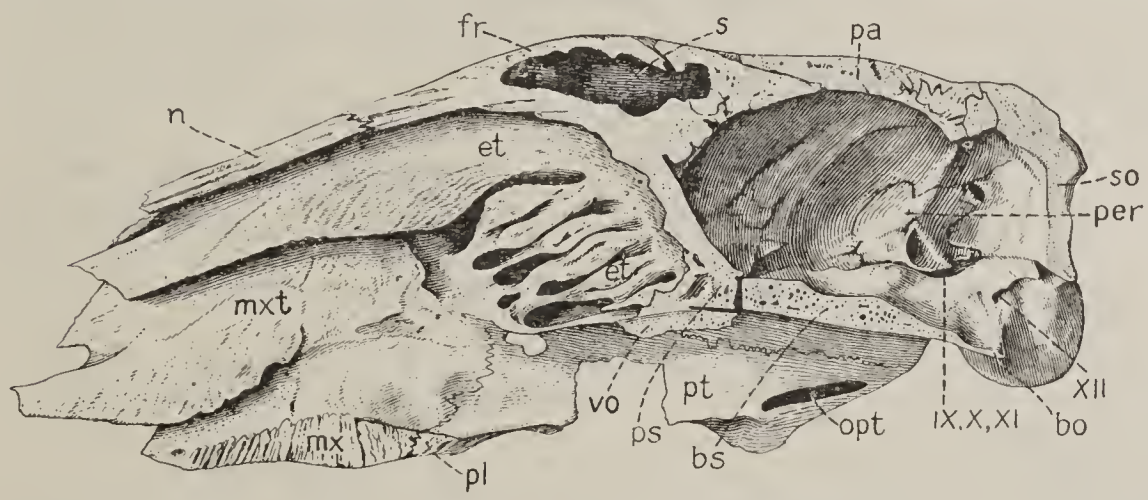


FIG. 11.—*Nothrotherium shastense* Sinclair. Vertical longitudinal section of skull No. 1800–6. × 0.33. *n*, nasal; *fr*, frontal; *s*, frontal sinus; *pa*, parietal; *so*, supraoccipital; *per*, periotic; *bo*, basioccipital; *bs*, basisphenoid; *ps*, presphenoid; *pt*, pterygoid; *opt.*, orifice of pterygoid sinus; *vo*, vomer; *pl*, palatine; *mx*, maxillary; *mxt*, maxilloturbinal; *et*, ethmo-turbinals; *IX*, *X*, *XI*, foramen lacerum posterius; *XII*, condylar foramen.

The paroccipital process, as in *Hapalops*, is inconspicuous, being much less prominent than in *Megalonyx*. Between it and the stylohyal process is a deep groove, which reaches the occiput and extends for a short way along its lateral border. The position of the occipital condyles with reference to the pterygoid bullae has already been noted. The condyles in ventral aspect are not obliquely placed, as in *Megalonyx*, and project posteriorly much less than in that genus or in *Megatherium*. They may be widely separated, as in No. 1800–4, or much closer together, as in No. 1800–7. By far the greater articulating surface of the condyles is directed downward, forward, and outward. Leidy states that in *Megalonyx* the articulating surface of the condyles is bent at about the middle. In No. 1800–6 the dorsal portion of the outer border of the condyle is curiously flattened by a rough and rather extensive surface. The foramen magnum may be transversely oval in shape. It opens more downward than in *Megalonyx*.

The base of the zygoma is long, and the glenoid fossa is somewhat concave transversely. The zygomatic process is quite like that in *Hapalops*, and differs from that in *Megalonyx* in not projecting so far from the side of the skull.

As in Miocene genera, the occiput of the Rancho La Brea *Nothrotherium* is nearly vertical or inclined slightly beyond the occipital condyles. The supraoccipital forms usually an extensive forwardly inclined surface. In posterior view (plate 3, fig. 4) the condyles are seen to be as a rule more widely separated than in *Hapalops*. In No. 1800–7 their position is more as in the latter genus. The posterior face of the condyles is relatively smaller than in *Hapalops*. The dorsal lip of the foramen magnum is notched

at the middle only in skulls 1800–13 and 1800–2. The median vertical ridge of the occiput does not usually reach the foramen magnum. It is sharp below, but greatly broadens dorsally on the surface of the supraoccipital. Where the vertical surface of the occiput meets the forwardly inclined surface, a heavy, rugose, transverse ridge is formed, as in *Megalonyx*. This ridge swings outward and downward and in some skulls is directly connected with the posterior surface of the stylohyal process. The crest of the occiput is not prominent, except along its lower end.

Skull 1800–6 is shown (fig. 11) in vertical longitudinal section. In contrast to the skull of *Mylodon*, that of *Nothrotherium* shows the presence of few sinuses. This is particularly noticeable in the parietal roof of the brain-chamber. A rather capacious sinus (*s*) is formed in the frontal and extends from the median septum laterally and ventrally. In the posterior region of the frontal the sinus overlies the front end of the brain-case. Here it has considerable dorso-ventral extent, but narrows toward the outer side. Farther forward the sinus reaches along the side of the ethmoids. The inflation of the pterygoid has already been mentioned.

TABLE 6.—*Measurements (in millimeters) of cranium of Nothrotherium shastense.*

	No. 1800–2	No. 1800–3	No. 1800–4	No. 1800–5	No. 1800–6	No. 1800–11
Length from anterior end of maxillaries to posterior end of occipital condyles	320	313.6	302	330	.....	309
Length from anterior end of nasals to posterior end of supraoccipital	339.8	333.3	320.4	352	339.5	336.3
Length of palate, from anterior end of maxillaries to postpalatine notch	141.7	131	127	144	.....	[1]135.4
Greatest width of palate anterior to first upper cheek-tooth (2)	45.8	42.9	42.9	48	.....	46.2
Width of palate between alveoli of second upper cheek-tooth (3)	22	20.6	21.4	21.8	24	23.6
Greatest width of pterygoid bulla	41.4	[1]37.9	17.4	[1]41.6	37.4	43.2
Greatest length of internal orifice of pterygoid bulla	37.6	36.7	21.7	.....	30.5	38.2
Greatest width of internal orifice of pterygoid bulla	.....	.....	[1]8.5	.....	12	14.4
Least distance between pterygoid bullae	.....	23.3	.....	21.8	21.3	.....
Mastoid width above stylohyal processes	112.8	114	110.5	120.6	114	118.4
Greatest width across occipital condyles	75.4	74.9	78.4	81.1	78.4	78
Transverse diameter of foramen magnum, internal measurement	33.5	32	30	36	31.8	29.6
Dorso-ventral diameter of foramen magnum, internal measurement	28.7	24.2	26.3	29.5	24.2	24.9
Height of occiput from plane of basioccipital to lambdoidal suture	79.6	78.5	80.7	85	76.5	87.7
Greatest width of muzzle at anterior end	70	73.9	65.5	73.4	73.4	78.2
Length of nasals	114.5	111.9	130.8	122.4	134.3	114.7
Greatest width above orbits	103.2	104.3	98.3	112.9	102.9	104.9
Least width behind orbit in region of coronal suture	78.2	78.5	82	83.8	77	80
Width, measured across anterior ends of zygomatic processes of squamosals	153.8	.....	.....	.....	.....	153.5
Least distance between outer sides of pterygoid plates	61	.....	.....	.....	.....	56.4
Greatest height from ventral border of pterygoid plate to highest elevation of frontals	134.7	.....	[1]130.3	.....	.....	139.9

[1] Approximate.

The longitudinal section through the skull brings to view also the structures lying in the nasal region. The mesethmoid forms a thin plate which divides the nasal cavity into two halves. The mesethmoid extends dorsally over the ethmoidal bones of each side. Posteriorly the mesethmoid is fused above with that portion of the frontal lying below the frontal sinus. The mesethmoid is joined below with the vomer. Seven endoturbinals (*et*) are found in *Nothrotherium shastense*. The first endoturbinal forms a large scroll which extends forward in the nasal cavity and covers anteriorly the maxilloturbinal.

MANDIBLE.

The most striking characteristic of the lower jaw of *Nothrotherium* is its great similarity to that of *Hapalops*. The former genus in this regard is decidedly closer to the Miocene form than to its Pleistocene contemporary *Megalonyx*. In general structure of mandible *Nothrotherium* bears the same relation to *Hapalops* as *Megalonyx* does to *Eucholoeops*. The lower jaw of an apparently adult individual (No. 1801–7) of the Rancho La Brea species is approximately twice as large as that in *Hapalops longiceps*. Although the mandible may very closely approach *Megalonyx* in total length, it differs from that genus in its very decided slenderness.

TABLE 7.—*Measurements (in millimeters) of mandible*[1] *of Nothrotherium shastense.*

	No. 1801–5	No. 1801–7	No. 1801–1	No. 1801–2	No. [2]1801–3	No. 1801–R–4	No. 1801–L–4
Length from anterior end of symphysis to posterior end of condyle	275	277.1	[3]260.7	284.4	[3]267	....	....
Distance from anterior end of symphysis to anterior border of alveolus for $\overline{2}$	100.9	106.2	[3]96.8	104.7	100.3	....	....
Distance from posterior border of alveolus for $\overline{4}$ to posterior end of angle	121.2	134.6	[3]120	124.3	117.1	....	....
Greatest length of symphysis	90.4	90.3	[3]82.9	90.2	87	....	....
Greatest depth between $\overline{2}$ and $\overline{3}$ measured normal to tooth row	56.6	60.6	54.2	56.1	53	61.3	61.6
Least height posterior to $\overline{4}$	43	47.5	42	44.8	38.6	46.8	47.5
Greatest height from angle to coronoid process	106.6	121.4	.....	[3]113.8	[3]101.7	....	....
Height of condyle above ventral border of angular process	79.7	.....	.....	.....	.....	26.4	26.8
Thickness of horizontal ramus at $\overline{3}$	27.2	29.3	26.7	28.2	25.3	....	....
Distance between inner alveolar borders of fourth cheek-teeth	33	30.7	.....	24.3	.....	....	....

[1] Where association of mandible with cranium is in doubt, the former is listed under a separate number.
[2] This mandible may belong to cranium 1800–4.
[3] Approximate.

In both *Hapalops* and *Nothrotherium* the predentary portion of the jaw is produced anteriorly into a long beak, which in the latter genus is also deeply concave. The edentulous beak or spout (plate 4, fig. 2, and fig. 12A) is much more elongate than in *Megalonyx*. The anterior end may be rather acutely tapering, as in No. 1801–7, or rounding, as in No. 1801–2.

As pointed out by Scott, the lower border of the ramus in *Nothrotherium* is less sinuous than in *Hapalops*. In the former genus it forms an even convexity which reaches its maximum development below the third inferior tooth. This border is more strongly convex than in *Megalonyx*, but decidedly less so than in *Megatherium*. The inferior border posterior to the tooth series and reaching to the end of the angular process is less decidedly concave in *Nothrotherium* than in *Hapalops*.

The symphyseal keel is long and sharp, but not as prominent as in *Megalonyx*. Usually but a single mental foramen is present. In No. 1801–2, however, a small opening is situated slightly above and posterior to the mental foramen of the right side. The horizontal limb of the ramus (plate 4, fig. 1) is noticeably of less height, especially in the anterior region, and less robust than in *Megalonyx*. With the disappearance of the first tooth in *Nothrotherium*, the deeply concave outer wall of the mandible between the caniniform tooth ($\overline{1}$) and the first cheek-tooth ($\overline{2}$) occurring in *Hapalops* and *Megalonyx* becomes greatly reduced and may be entirely absent, as in No. 1801–5. There are frequently two foramina representing the postero-external opening of the dental canal in the Rancho La Brea species. In No. 1801–7 two foramina are present on the left ramus and one on the right, an occurrence similar to that in a mandible of *Hapalops lon-*

giceps (No. 15523, Prin. Univ. Coll.), while in No. 1801–2, from Rancho La Brea, there are two foramina on each side. The anterior foramen is situated on the outer surface of the ramus, opposite the last inferior tooth, and the second opening is at or slightly above the base of the ascending process.

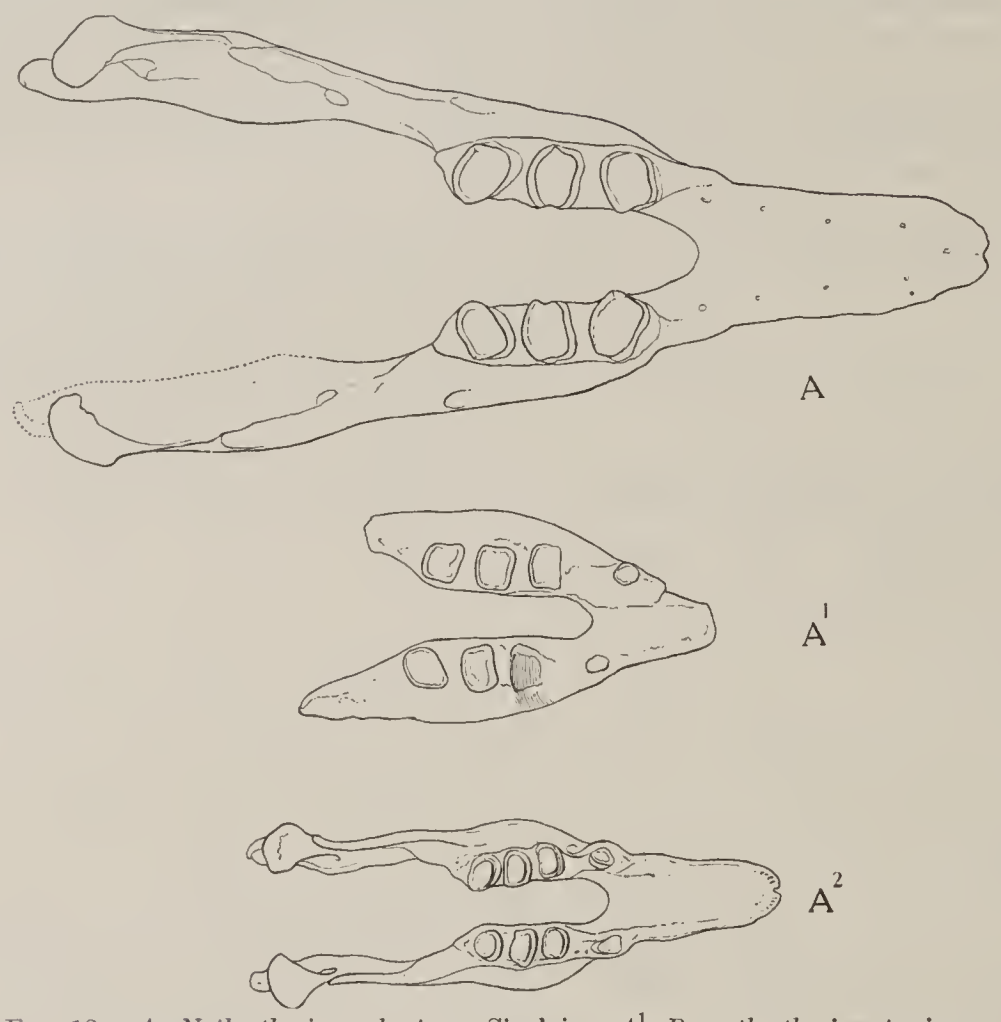


FIG. 12.—*A*, *Nothrotherium shastense* Sinelair. A^1, *Pronothrotherium typicum* Ameghino. A^2, *Hapalops longiceps* Scott. Dorsal view of mandible, × 0.33. A^1, after Rovereto; A^2, after Scott.

The coronoid process arises well to the outer side of the last cheek-tooth ($\bar{4}$), as in *Hapalops*, but is relatively smaller than in the latter. It may be broad, as in No. 1801–2, or rather narrow. The sigmoid notch, due to the high position of the condyle above the tooth row in *Nothrotherium*, is relatively much smaller than in the Miocene genus. In

TABLE 8.—*Measurements (in millimeters) of superior dentition of Nothrotherium shastense.*

	No. 1800–2	No. 1800–3	No. 1800–4	No. 1800–5	No. 1800–6	No. 1800–9	No. 1800–10	No. 1800–11	No. 1800–12
Greatest length of superior molar series alveolar measurements..	61.6	57.5	61.5	65.4	62.3	....	....	62.8	....
2, greatest antero-posterior diameter.....	12	[1]12.3	12.1	12.4	....	9.9	10.4	12	9.7
2, greatest transverse diameter..	12.9	[1]13.7	13	14.3	....	11.9	10.5	13	11.2
3, greatest antero-posterior diameter.....	....	[1]14	13	13.8	....	....	....	13.3	11
3, greatest transverse diameter..	....	[1]16.8	16.9	18.9	....	....	....	16.8	14.4
4, greatest antero-posterior diameter.....	13.2	13	12.8	12.1	....	....	11.2	13	10.8
4, greatest transverse diameter..	17	17	17	18.3	....	....	14.4	17.2	13.5
5, greatest antero-posterior diameter.....	8.7	[1]7.8	7.3	8.8	....	7.5	7.3	7.6	7.2
5, greatest transverse diameter..	13.6	[1]12.9	13.8	16	....	11.3	11.5	14.4	10.5

[1] Approximate.

No. 1801–7 the condyle in dorsal view has much the shape seen in *Hapalops longiceps.* In No. 1801–2 and No. 1801–1 the condyle has a greater oblique diameter and is more slender than in No. 1801–7. The ventral notch between condyle and angle is relatively wider than in *Hapalops,* while the angular process in some specimens from the asphalt extends posteriorly as a more slender hook than in *H. longiceps.* The angle of the jaw is much more slender in *Nothrotherium* than in *Megalonyx.* In *M. jeffersonii* the coronoid and angle are more nearly equally spaced on either side of the condyle than in the Rancho La Brea genus. The inferior border of the angle is deflected inward, forming a more pronounced shelf than in *Megalonyx.*

TABLE 9.—*Measurements (in millimeters) of inferior dentition of Nothrotherium shastense.*

	No. 1801–5	No. 1801–7	No. 1801–1	No. 1801–2	No. [1]1801–3	No. 1801–R–4	No. 1801–L–8
Greatest length of inferior molar series alveolar measurements	57	54.7	51.7	59	51.7	49.4	48.5
$\underline{2}$, greatest antero-posterior diameter	13.6	....	13.9	13.6	....	[2]12.5	[1]11.8
$\underline{2}$, greatest transverse diameter	16.5	....	15.9	17.6	....	[2]16.3	[1]16.2
$\underline{3}$, greatest antero-posterior diameter	14.2	13.5	[2]14.7	14.1	....	13.3	13.4
$\underline{3}$, greatest transverse diameter	17	17.5	16	18.4	....	16.4	16.4
$\underline{4}$, greatest antero-posterior diameter	14	15	....	13.4	14	14.5	[1]15
$\underline{4}$, greatest transverse diameter	15.6	15.8	....	16.2	15	15	14.8

[1] This specimen may belong to cranium 1800–4. [2] Approximate.

DENTITION.

Dental formula: $\frac{4-4}{3-3}$

In the loss of the anterior or caniniform teeth, *Nothrotherium* differs markedly from known Miocene Megalonychinae and Megatheriinae as well as from the Pleistocene genus *Megalonyx.* All the teeth are considerably smaller than in *Megalonyx.* The external layer of cement on the teeth may be only as thick relatively as in *Hapalops.*

Superior series.—The tooth-rows extend nearly parallel, the palate increasing slightly in width between the fifth cheek-teeth. The teeth are more closely spaced than in Miocene genera. In the Rancho La Brea species the largest interspace occurs between the alveoli of the third ($\underline{4}$) and fourth ($\underline{5}$) cheek-teeth. Reinhardt states that in the Brazilian species of *Nothrotherium* the teeth are equally spaced.

As in the various species of Santa Cruz ground-sloths, the differentiation of the superior molariform teeth into a small $\underline{2}$, much larger $\underline{3}$ and $\underline{4}$, and a $\underline{5}$, greatly compressed antero-posteriorly, occurs also in *Nothrotherium,* though the differences between $\underline{2}$ and $\underline{3}$ or $\underline{4}$ is not as marked in the former as in the latter. The teeth in *Nothrotherium* are noticeably more complex. This is indicated by the presence of distinct, median vertical grooves on the outer faces of $\underline{2}$, $\underline{3}$, and $\underline{4}$, and to a less extent also on the inner faces. Even $\underline{5}$, which is much more compressed antero-posteriorly than the other superior teeth, shows a distinct groove on the outer face and a much more faintly developed one on the inner. *Nothrotherium,* therefore, differs from *Megalonyx,* in which such distinct lateral grooves are lacking on these teeth. In *Hapalops indifferens* the vertical grooving on the outer faces of $\underline{2}$, $\underline{3}$, and $\underline{4}$ has been noted by Scott in some specimens. In describing the corresponding teeth, as well as $\underline{5}$, in *H. elongatus,* Scott (1903, p. 218) states that "the vertical grooving of these teeth appears to be very capriciously present or absent." Judging from the appearance of the occlusal surface, the outer compact layer of dentine in all the superior teeth of *Nothrotherium* is best developed on the anterior and posterior surfaces and least developed on the outer and inner sides. In $\underline{2}$, $\underline{3}$, and $\underline{4}$, this layer is slightly thicker on the outer than on the inner surface. In $\underline{5}$ the layer is thickest on the posterior face, while on the outer and inner faces it is of equal thickness.

The first cheek-tooth (2) is smaller than 3 and 4. Contrasted with the latter teeth, 2 is relatively narrow transversely in *Nothrotherium*. It is relatively longer anteroposteriorly than in the *Hapalops*. The tooth may be trapezoidal in shape, with anterior and posterior faces parallel, as in No. 1800–4, or these faces may converge to the outer side, as in skull 1800–11. The anterior and posterior faces are nearly flat and the angles are well rounded; 2 thus differs from the corresponding tooth in *Megalonyx*, which Leidy (1855, p. 17) has described as follows:

"The second upper molar in section (Pl. XVI, Fig. 9, *d*), is quadrate with rounded angles. Its inner and posterior sides are the greater, and are nearly equal; and the remaining sides are also nearly equal, and are planes. The inner side is slightly convex, and the posterior side is nearly a plane and is directed obliquely outward."

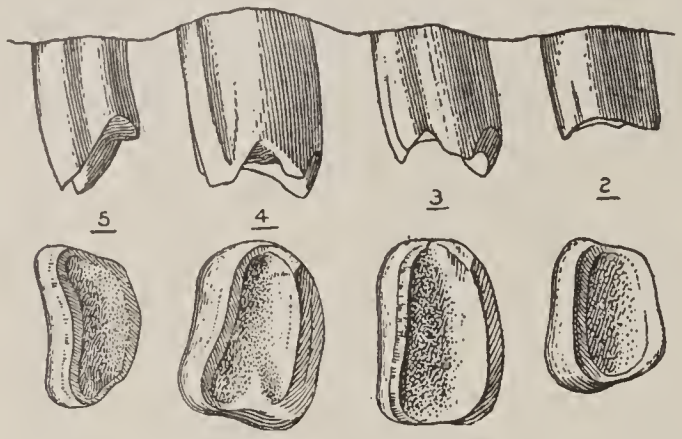


FIG. 13.—*Nothrotherium shastense* Sinclair. Superior dentition. Lateral and occlusal views. × 1.

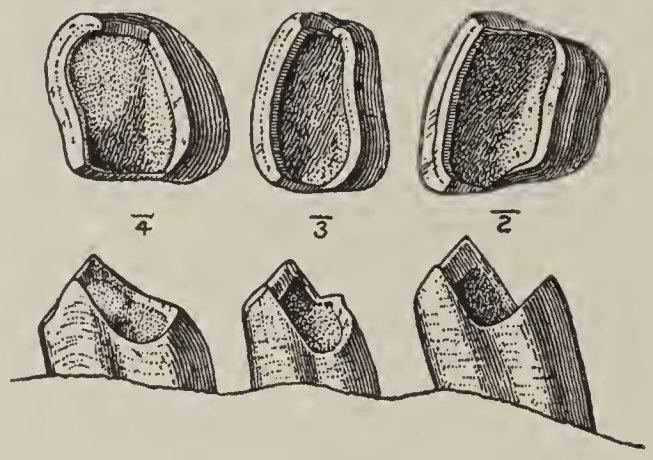


FIG. 14.—*Nothrotherium shastense* Sinclair. Inferior dentition. Lateral and occlusal views. × 1.

On the occlusal surface the transverse valley between the anterior and posterior crests opens most broadly on the inner side in No. 1800–11. In No. 1800–4, on the other hand, where the transverse crests are parallel, the valley is of nearly the same width throughout.

TABLE 10.—*Measurements (in millimeters) of endocranial casts.*

	Nothrotherium No. 1800–1.	Hapalops.
Greatest length from anterior end of cerebrum to posterior end of cerebellum	102.4	67.7
Greatest transverse diameter of anterior end of cerebrum	67	[1]39.6
Greatest transverse diameter of posterior end of cerebrum	84.7	[1]49.2
Transverse diameter of cerebellum	66.6	40
Height from infundibulum to dorsal surface of cerebrum	61.8	[1]32.4

[1] Approximate.

The second and third superior cheek-teeth (3 and 4) are very similar in general shape; 3 may be slightly larger than 4, but the corresponding measurements of these teeth are usually very close. In the greater number of species of *Hapalops*, 3 is the largest of the molariform series, and this is true in general for the Santa Cruz Megalonychinae. In both teeth the anterior face is broadly convex and the posterior face concave. The anterior face rounds gradually to the external side; in other words, does not form a distinct angle with the outer side, as in other cheek-teeth. The teeth do not narrow so much externally as in *Megalonyx jeffersonii*, in which respect they are more like *M. leidyi*. They lack the typical quadrate cross-section characteristic of the corresponding teeth of *Megatherium*. In 3 and 4 the anterior crest of the occlusal surface is decidedly beveled in front, and the cutting-edge of this chiseled surface is usually worn into a crescent. The transverse valley is worn most broadly on the inner side. In both teeth the postero-internal angle of the occlusal surface is subjected to greatest wear. In

several loose teeth of *Nothrotherium* from the asphalt beds, referable to $\underline{3}$ or $\underline{4}$, the outer face is seen to be noticeably concave in its longitudinal extent. This character apparently distinguishes the teeth from $\overline{3}$ and especially from $\overline{2}$.

TABLE 11.—*Vertebral formulae.*

	C.	Th.	L.	S.	Cd.
Nothrotherium shastense	7	17?	3	5	21
Hapalops longiceps (after Scott)	7	22	3	6	20±
Hapalops elongatus (after Scott)	7	21–22	3–4	5–6	20±
Megatherium americanum (after Flower)	7	16	3	5	17
Myrmecophaga jubata (after Flower)	7	15	3	5	29

The fourth or last cheek-tooth ($\underline{5}$) resembles in its antero-posterior compression the corresponding tooth in *Hapalops* and in *Megalonyx*. It is approximately only one-half as long in that direction as the remaining superior cheek-teeth of *Nothrotherium*. The posterior face of $\underline{5}$ in the species from the asphalt beds is very broadly concave and the concavity may become quite deep, as in a young individual (No. 1800–12). The nearly flat anterior face, which is of less width than the posterior face, may have a median strip defined by a slight groove on each side. The inner face may have a faint vertical groove near the anterior border, while the outer face is characterized by a well-marked median groove. On the occlusal surface there is no distinct valley formed, but the anterior edge is worn much lower than the posterior. This tooth differs decidedly from $\underline{5}$ in *Megalonyx jeffersonii*, which Leidy (1855, p. 18) describes as follows:

"The last molar is a smaller tooth than the preceding pair, but has nearly the same form in a reversed position, the base of the triangular section (Pl. XVI, Fig. 9, *a*) being outward. Its posterior side is transverse and is slightly concave; and the anterior side is convex and directed obliquely inward."

Inferior series.—The tooth-rows are relatively as far separated as in *Hapalops longiceps*. They are very nearly parallel or diverge slightly posteriorly. In the Pleistocene genus the characteristic features of the three posterior teeth in *Hapalops* have been accentuated. Scott (1903, p. 182) describes these teeth in *H. longiceps* as follows: " . . . $\overline{2}$ and $\overline{3}$ are transverse and rectangular, and their raised margins are quite deeply notched on the inner and outer sides by the transverse valley; $\overline{4}$ is sub-cylindrical, as in most of the other species."

In the first and second inferior cheek-teeth ($\overline{2}$ and $\overline{3}$), the denser, outer layer of dentine of the tooth-crown is least developed along the outer and inner sides. It is perhaps less developed on the outer than on the inner side. The layer is thicker on the

TABLE 12.—*Measurements (in millimeters) of atlas.*

	No. 1802–1	No. 1802–2	No. 1802–3	No. 1802–4	No. 1802–5
Greatest transverse width aeross lateral wings	140.4	153.3	145.8	130	145.3
Greatest antero-posterior diameter	63.3	65.4	65.5	63	69.7
Antero-posterior diameter of dorsal areh over neural eanal along median line	33.8	31.9	41.4	29.2	41.2
Antero-posterior diameter of ventral areh under neural eanal along median line	24.4	23.6	25.3	21	24.6
Distanee from antero-external border to lateral faeet for axis	43.7	48.3	45.7	39.4	43.6
Greatest transverse distanee between posterior borders of faeets for axis	71.1	76	78.8	69.5	74.7
Least transverse distanee between anterior borders of faeets for axis	30.8	31.3	33.8	28.4	27.9
Greatest height of neural canal at posterior end, internal measurement	44	44	51.2	43.2	46.8

anterior and posterior faces of the crown, and appears slightly better developed on the posterior face. The thickness of this more compact layer of dentine determines in part the structure of the occlusal surface. The outer and inner walls, which are thinnest, resist wear less, and are worn down more rapidly than the anterior and posterior walls. The latter are therefore prominent on the wearing surface as two transverse ridges with intervening valley excavated in the softer inner material of the crown. The type of wearing surface thus obtained resembles very much that in the larger teeth of *Megatherium*, but in that genus the outer compact dentine is thinner and the cement (on the anterior and posterior faces) relatively much thicker. In the Rancho La Brea *Nothrotherium* the cement is more evenly distributed on the crowns of the teeth, with a moderate increase on the anterior and posterior faces in some specimens. In *Megatherium* there is an excessive thickening of the cement on the anterior and posterior faces.

TABLE 13.—*Measurements (in millimeters) of axis.*

	No. 1803–1	No. 1803–2	No. 1803–3	No. 1803–4	No. 1803–5	No. 1803–6	No. 1803–7
Greatest length along median ventral line	70.9	69.8	81.6	82	82.6	[1]72.8	75.3
Greatest vertical height	73.3	77	81.4	77.6	76	80.4	73.7
Least width behind articulating surfaces for atlas	58.4	60.8	65	[1]65	[1]60	66.4	63
Dorso-ventral diameter of centrum across posterior face	21.6	22	24.8	22.8	23	29.5	23.7
Greatest transverse width of centrum across posterior face	37.2	34.4	39.3	39.2	[1]34.5	37.3	35.6
Greatest transverse diameter of neural canal at anterior end	35.8	30.6	35.3	35.4	35.3	35.5	31.8
Greatest width across posterior ends of transverse processes	[1]82.8	89	[1]98.2	[1]93	....	[1]104.6	96.7
Distance from anterior end of neural spine to posterior end of neural arch	57.2	49	68.6	66.6	67	62	57.7
Width across postzygapophyses	62.4	58.9	71.1	65.2	66.3	66	70.3
Least distance from antero-lateral border of neural canal to notch below postzygapophysis	24.9	20	26	23.7	26.3	22.6	27.3
Greatest width across posterior ends of lateral facets for atlas	70.9	69.3	72	73.3	72.4	75.7	71.9
Distance from anterior border of lateral facet for atlas to posterior end of transverse process	68	66.8	76.3	76.9	....	66.3	72

[1] Approximate.

The complete length of the crown of $\bar{2}$, $\bar{3}$, and $\bar{4}$ is exposed in the somewhat broken specimen, No. 1801–1. The teeth are seen to reach the inferior walls of the ramus, which is very thin. In this ramus the inferior teeth diverge upward in their course from the base to the alveolar border. In longitudinal extent the crown of $\bar{2}$ is slightly concave posteriorly; $\bar{3}$ is practically straight posteriorly, but slightly concave laterally; $\bar{4}$ evidently sloped posteriorly; $\bar{3}$, and especially $\bar{2}$, exhibit, then, a different longitudinal curvature from that shown by the third and fourth superior teeth.

In $\bar{2}$ (fig. 14) the transverse width of the anterior half is distinctly less than that of the posterior half. The transverse axis of the tooth is oblique to the long axis of the tooth-row. This tooth differs from the corresponding one in *Hapalops* and *Megalonyx* in the presence of median vertical grooves on the inner and outer faces. The anterior face is broadly concave, while the posterior face is correspondingly convex. On the occlusal surface the anterior transverse ridge is nearly straight and may be beveled in front, while the posterior is crescentic and is beveled behind.

The second inferior cheek-tooth ($\bar{3}$) is slightly larger than $\bar{2}$, and narrows more toward the inner side. It is transversely placed with reference to the long axis of the tooth-row. In occlusal view it resembles somewhat the third and fourth superior teeth, but is in reverse position. If the tooth is oriented so that the posterior margin of the

occlusal surface corresponds to the anterior margin of the third or fourth superior tooth, the former can be distinguished by rounding less gradually toward the narrow lateral side. In other words, the third inferior tooth has all four angles better defined than those in the third and fourth superior teeth. This serves also to distinguish $\overline{2}$ from either $\overline{3}$ or $\underline{4}$. The vertical grooves of the lateral faces appear, as a rule, to be more sharply defined than in $\overline{2}$, while the anterior half of the tooth is not as distinctly smaller transversely as the posterior half. The second inferior cheek-tooth ($\overline{3}$) differs from the corresponding tooth of *Hapalops* and *Megalonyx* in the presence of well-marked lateral grooves. The anterior and posterior faces resemble those in $\overline{2}$.

TABLE 14.—*Measurements (in millimeters) of third cervical vertebra.*

	No. 1804–1	No. 1804–2	No. 1804–3	No. 1804–4	No. 1804–5	No. 1804–7	No. 1804–16
Length of centrum measured over ventral surface	46.7	49.7	48.3	....	....	46.8	....
Width of centrum measured over anterior face and between inner borders of vertebrarterial canals	39.8	40.2	41.4	44.5	34.8	35.3	36.3
Depth of centrum measured over anterior face and normal to dorsal surface	17.1	15	17.8	....	17.6	14.9	17.3
Height from ventral border of posterior face of centrum to tip of neural spine	75.9	71.8	73.6	[1]74	[1]73	71.3	[1]67
Width across outer sides of prezygapophyses	86.8	84.4	91.8	81	74.4	83	78.7
Greatest width across postzygapophyses	67.9	63	70.8	64.6	61.4	71 4	61.4
Greatest width of posterior side of neural spine	....	22	26.2	23.9	18.9	24.7	19.2
Greatest width across posterior ends of ventral wings	104.5	111.5	109.2	....	....	....	....
Length of ventral wing	63	65.2	68.8	....	[1]58.5	[1]61	[1]61

[1] Approximate.

The last inferior tooth ($\overline{4}$), which in *Hapalops* is more or less cylindrical in shape, retains the rounded internal side in *Nothrotherium*. It thus agrees with *Megalonyx* in differing markedly in shape from either $\overline{2}$ or $\overline{3}$. This tooth in *Megatherium*, although smaller and relatively longer antero-posteriorly than $\overline{2}$ and $\overline{3}$, is essentially of same shape as the other inferior teeth. The transverse axis of $\overline{4}$ in *Nothrotherium* is directed obliquely to the long axis of the tooth-row, the genus thus resembling *Hapalops* and *Megalonyx*. On the outer flattened face of this tooth a median vertical groove may be slightly defined, as in No. 1801–7, or well defined, as in No. 1801–2. In the presence of this groove *Nothrotherium* differs from *Hapalops* and possibly from *Megalonyx*. The outer anterior and posterior corners of $\overline{4}$ are well rounded. The denser layer of dentine is best developed on the inner and posterior sides and least on the outer side. The border of the occlusal surface is least worn at the middle of the inner side and at the postero-external corner. Between the resulting prominences the border is beveled posteriorly. In *Megalonyx* the occlusal surface of the corresponding tooth is somewhat similarly worn. It is described by Leidy (1855, p. 19) as having "a transverse valley, whose boundaries are most prominent at the antero-internal and postero-external angles."

ENDOCRANIAL CAST.

In plate 3, figures 1, 2, and 3, are shown the dorsal, lateral, and ventral views respectively of the endocranial cast of *Nothrotherium shastense*, and figures 4, 5, and 6 give the comparable views of the endocranial cast of *Hapalops* sp. In the preparation of these casts and of that of *Mylodon harlani*, the cranium of each form was sectioned in the sagittal plane and a glue cast made of the brain-chamber and of adjacent openings for the principal cranial nerves and blood-vessels. A glue mold was then made from the

glue cast and from this mold the final casts of plaster of paris were obtained. By the application of this method satisfactory results were secured by Mr. J. W. Lytle at the Los Angeles Museum. A skull kindly furnished by Dr. W. J. Sinclair was used for the endocranial cast of *Hapalops*. The glue cast of the cranial cavity expresses details of structure more clearly than the plaster cast and is therefore preferable to the latter in a study of the surface features.

The endocranial cast of *Nothrotherium* is distinctly larger than that of *Hapalops*, but is somewhat smaller than that of *Mylodon harlani* (compare plate 3 with plate 26). The surface of the cerebrum is more richly convoluted in the Pleistocene megalonychid ground-sloth than in the Miocene form. The forward portion of the cerebrum shows also a fuller development than in *Hapalops*. When viewed from the dorsal side the

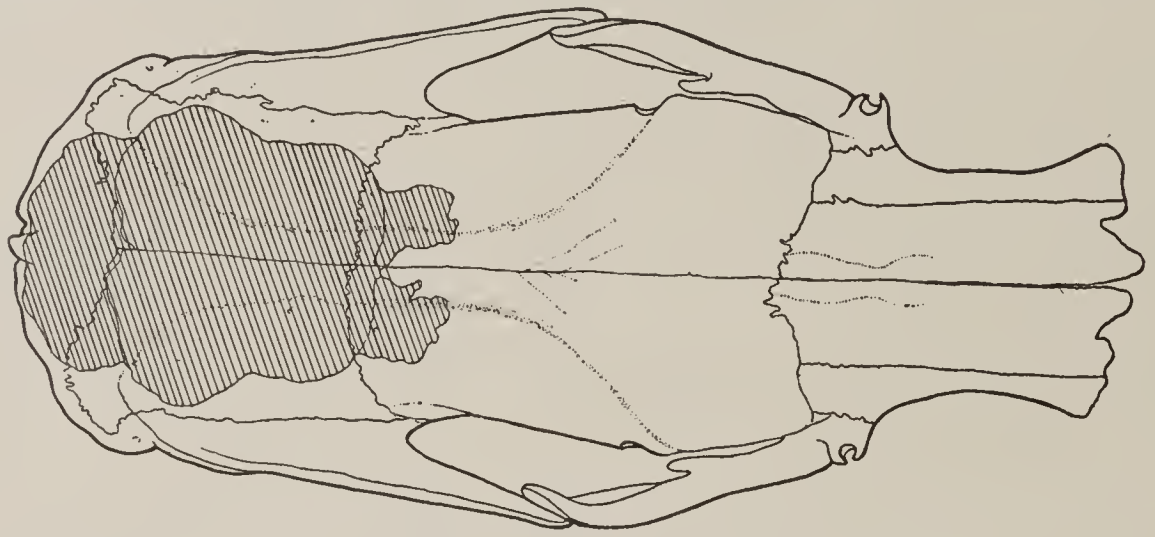


FIG. 15.—*A*, *Nothrotherium shastense* Sinclair. A^1, *Hapalops* sp. Views showing relation of size of endocranium to that of skull. × 0.33.

cerebellum in both *Nothrotherium* and *Hapalops* is seen to be separated by a distinct cleft or fissure from the cerebrum. The two lateral and the median lobes of the cerebellum are discernible on the endocranial cast of the Pleistocene genus, but are not so pronounced as in *Hapalops*. In a lateral view the cerebellum appears to be better defined and relatively larger in *Nothrotherium* and *Hapalops* than in *Mylodon harlani*.

ELEMENTS OF HYOID ARCH.

Only the stylohyal and basihyal elements are available of the chain of bones in the hyoid apparatus of *Nothrotherium*.

The stylohyal, as contrasted with that of *Mylodon*, is of course much more slender. The shaft is straighter, with the lateral surface flattened and the median surface convex; the proximal third is expanded, but the posterior end of this portion is not so prominently developed above the anterior end and is relatively thicker than in *Mylodon*.

The basihyal, with which the thyrohyals are ankylosed, differs from the corresponding element in *Megalonyx jeffersonii* in decidedly less prominent and more widely separated

surfaces for ceratohyals. In No. 1541 L. A. M. the diverging arms do not taper to the free end, but broaden at the tips, and this broadening is even more distinct in *Nothrotherium* than in *Mylodon*. The length of the arm is 51 mm. as contrasted with approximately 68 mm. for a similar measurement in *M. jeffersonii*. The facets borne by the arms are relatively large. When viewed from in front the inner surfaces are seen to be directed more anteriorly than in the element of *M. jeffersonii* and also in that of *Mylodon harlani*.

The measurements (in millimeters) are as follows:

Stylohyal No. 1540: Greatest length, 97.4; width of proximal expansion, 31.3.
Basihyal No. 1541: Greatest width aeross extremities of diverging arms, 61.8; greatest width over facets for ceratohyals, 17.

TABLE 15.—*Measurements (in millimeters) of fourth cervical vertebra.*

	No. 1805–1	No. 1805–2	No. 1805–3	No. 1805–4	No. 1805–5	No. 1805–6
Length of centrum measured over ventral surface.	47.5	48	[1]39	[1]40	49.4	49
Width measured over anterior face of centrum and between inner borders of vertebrarterial canals	39.7	39.3	37	36.7	42	40.8
Depth of centrum measured over anterior face and normal to dorsal surface	17.4	17.4	18	18	15.1	18.4
Height from ventral border of posterior face of centrum to tip of neural spine	72.8	78	[1]67	[1]65	76.9	78
Width across outer sides of prezygapophyses	94.3	89.4	79.2	85	87.8	[1]91
Greatest width across postzygapophyses	65.7	66.4	62.9	67.3	64.1	74
Greatest width of posterior side of neural spine	26.5	23.9	16.6	....	20.4	28.2
Greatest width across posterior ends of ventral wings	[1]110	102.6	....	[1]97	111.4	109.8
Length of ventral wing measured along lower border	67.7	56.8	....	48.2	64.6	68

[1] Approximate.

VERTEBRAE.

We note from table 11 that *Nothrotherium* resembles *Hapalops* in number of vertebrae in the cervical, lumbar, sacral, and caudal regions, while the greatest difference occurs only in the thoracic section. In both *Nothrotherium* and *Hapalops* the cervical region is long (plate 4, figs. 3 and 4). In the former genus the length of the series exceeds that of the series in *Mylodon harlani*. While no complete series of thoracic vertebrae of a single individual has been obtained from the asphalt deposits, there appear to be 17 segments in this region of the column in *Nothrotherium* (plate 5). The reduction of thoracic vertebrae from the number characteristic of *Hapalops* represents one of the most fundamental changes in the skeleton that has occurred in the derivation of the Pleistocene genus from its Miocene ancestor. The shortened trunk in *Nothrotherium* is comparable to that seen in other Pleistocene ground-sloths. No ankylosis of lumbar and sacral vertebrae is known to occur in *Nothrotherium* as in *Mylodon*. A greater number of vertebrae are present in the tail of the Pleistocene megalonychid than in that of *Megatherium*, but this number is distinctly less than that in the tail of the great ant-eater.

Cervical vertebrae.—The individual vertebrae are characterized by their broadness and, in decided contrast to those of *Mylodon*, their greater antero-posterior extent. They resemble the cervical vertebrae of *Hapalops* in both of these features, but with the latter character somewhat less developed. The neural canal is noticeably less capacious than in cervical vertebrae of the Miocene genus. The centrum in this region of the column is depressed, relatively more so than in *Hapalops elongatus*. The anterior face of the centrum is convex, the posterior face slightly concave. The dorsal surface (within the neural canal) is perforated at the middle by two nutritive foramina. The ventral surface is keeled, the median ridge tending to become obscure in posterior

vertebrae. On either side of this ridge a rude protuberance on the ventral surface extends beyond the border of the posterior face. These processes are most conspicuous in the fourth and fifth vertebrae. The centra in the cervical region of the Pleistocene form partake of the relative shortening which distinguishes the vertebrae from those of *Hapalops*.

The atlas resembles considerably that of *Hapalops*. In anterior view it differs from that of *Megalonyx* in a broader doming of the dorsal arch of the neural canal. This arch bears above a rudimentary tubercle representing the spine. The articulating facets for the occipital condyles are deeply concave and have their median internal walls incised by a roughened surface. This indentation divides each surface into a large ventral portion and a smaller dorsal portion corresponding to the two principal surfaces of the occipital condyles. The ventral arch to the neural canal is deeply notched anteriorly, as in *Hapalops* and differs thus from *Megalonyx* and from *Mylodon*. It bears also on the lower side a hypapophysial tubercle as in the atlas of *H. elongatus*. The articulating facet on the inner side for the odontoid process of the axis has the long diameter transverse.

TABLE 16.—*Measurements (in millimeters) of fifth cervical vertebra.*

	No. 1806–1	No. 1806–2	No. 1806–3	No. 1806–4	No. 1806–5
Length of centrum measured over ventral surface	46.8	[1]43	46.6	....	....
Width of centrum measured over anterior face and between inner borders of vertebrarterial canals	39.5	37.8	43.7	44.6	44
Depth of centrum measured over anterior face and normal to dorsal surface	18	19.9	17.1	....	16
Height from ventral border of posterior face of centrum to tip of neural spine	78.7	[1]82	77.7	[1]75	....
Width across outer sides of prezygopophyses	92.5	89.5	99	88.6	87.4
Greatest width across postzygapophyses	65.6	65.6	73.2	70.6	61.9
Greatest width of posterior side of neural spine	....	25.5	29	23.7	18.2
Greatest width across posterior ends of ventral wings	[1]112	[1]103	113	103	112.8
Length of ventral wing measured along lower border	....	64	63.8	53.1	57.7

[1] Approximate.

The lateral wings or processes of the atlas reach their greatest lateral extent at approximately the posterior third of the vertebra. They are not broadly developed anteriorly as in *Mylodon*, and are not deflected downward so extensively at the posterior side, as in that genus. The posterior border of the lateral processes is not so deeply notched, adjacent to the articulating surfaces for the axis, as in the first cervical vertebra of *Megalonyx*. The course of the vertebrarterial canal is very similar to that in the atlas of *M. jeffersonii*, which has been adequately described by Leidy (1855, pp. 20–21). The various openings of this canal in *Nothrotherium* become successively smaller anteriorly.

The axis in lateral aspect is seen to differ noticeably from that of *Megalonyx jeffersonii* in the following characters: (1) the lateral wall of the neural canal is relatively much longer antero-posteriorly; (2) the greatest height of the neural spine is reached in front of the posterior zygapophysis, while in *Megalonyx* the highest point lies above the posterior zygapophysis; (3) the anterior end of the neural spine is pointed in *Nothrotherium;* (4) the posterior border of the lateral wall of the neural canal is oblique; and (5) the odontoid process projects relatively farther beyond the lateral facets for the atlas than in *Megalonyx*.

The neural spine is wide, flattened above, and flares or widens considerably at the posterior end. The centrum is depressed and carries a keel ventrally which widens posteriorly, thus resembling *Hapalops*. The transverse processes are slender, as in the second vertebra of the latter genus. The odontoid process may show but little inclination

upward, as in No. 1803–3. The facet on the ventral side of the odontoid process is oval in shape, with greatest diameter antero-posteriorly. The posterior zygapophyses may be flat, and may face downward or decidedly outward as well (1803–4).

TABLE 17.—*Measurements (in millimeters) of sixth cervical vertebra.*

	No. 1807–1	No. 1807–2	No. 1807–3	No. 1807–4	No. 1807–5	No. 1807–6	No. 1807–7
Length of centrum measured over ventral surface	[1]44	47.6	45	46.2	....	....	41.8
Width of centrum measured over anterior face and between inner borders of vertebrarterial canals	41.2	42	46.6	44	47	41	37.4
Depth of centrum measured over anterior face and normal to dorsal surface	17.2	18.2	20.1	17.9	....	....	17.4
Height from ventral border of posterior face of centrum to tip of neural spine	[1]90	86	89	101	[1]84	....	83.7
Width across outer sides of prezygapophyses	[1]92	87.8	96.6	82.6	90.3	81.4	86.9
Greatest width across postzygapophyses	76.6	69.3	74.3	58.7	....	61.2	63.7
Greatest width across ventral wings	95	113.7	108.6	112.6	....	87.7	....
Greatest length of ventral wing	[1]63	66.2	78	56.8	59	46.7	67.3

[1] Approximate.

Between the axis and the seventh vertebra the segments possess low neural spines, while that of the seventh is decidedly higher. On the latter vertebra the spine is usually relatively larger and heavier than in *Hapalops*. The vertebrae posterior to the axis are also remarkable for their well-developed transverse processes and haemapophyses. In these characters they show considerable likeness to the cervicals of *Hapalops*. With the shortening of the vertebrae the anterior and posterior zygapophyses form relatively much less extensive surfaces of articulation, the pedicles of the neural arch are narrower, and the notch below the posterior zygapophysis is less conspicuous than in cervicals of *H. elongatus*.

Cervical vertebrae 3 to 5 inclusive have the neural spine flaring or widening posteriorly, a character which is possessed also by the spine of the axis. In the sixth vertebra the spine is slightly higher than in preceding vertebrae and the posterior width is not so great. The posterior border of the neural arch at the base of the neural spine in these vertebrae is deeply notched.

In proceeding backward from the axis the simple transverse process is retained for the most part in the third vertebra. It has flattened and broadened somewhat. In the fourth it shows signs of bifurcation at the outer posterior end, and this division becomes much more evident in the fifth. Here the lower part develops into a decided

TABLE 18.—*Measurements (in millimeters) of seventh cervical vertebra.*

	No. 1808–1	No. 1808–2	No. 1808–3
Length of centrum	38.8	....	41.4
Width of centrum measured over anterior face	43.5	40.8	41
Depth of centrum measured over anterior face	22.4	24.2	22
Width across metapophyses	95.4	86.8	79.4
Greatest width across transverse processes	136.1	145.4	128.8
Width across pleurapophyses	[1]77	62.8	64
Length of neural arch, measured from anterior end of prezygapophysis to posterior end of postzygapophysis	60.3	59.8	64.9
Width across postzygapophyses	77.6	66.1	65.6
Height, measured from middle of ventral border of posterior face of centrum to end of neural spine	131.6	[1]134	138.6
Dorso-ventral diameter of neural canal, measured at anterior end	24	22	24.7
Transverse thickness of neural spine at middle	10.5	14	13.7

[1] Approximate.

inferior plate which reaches its maximum size in the sixth vertebra. As in *Hapalops*, it extends well below the ventral surface of the centrum. The diapophysis in the sixth vertebra has shifted forward and may in turn be bifid, in which case the upper portion is heavier than the lower. In the seventh cervical the diapophysis forms a decided transverse process which extends well outward and downward, while the inferior lamella lies much more to the ventral side of the centrum than it does in the sixth and has become much reduced. There is, in other words, a rapid decrease in size of the inferior lamella from the sixth to the seventh vertebra.

The much greater development of the lateral wings of the cervical vertebrae, together with greater length of centra, are decided differences that exist between *Nothrotherium* and *Mylodon* in this region of the column. An effective scalene musculature is thus indicated in the former genus. Probably with the unusually developed inferior lamellae is to be correlated a greater degree of vertical flexibility of the neck than exists in *Mylodon*. The bending of the neck in this direction seems to have been facilitated also by the deep notching of the posterior border of the neural arch. Length of articulated cervical series, 1 to 7 inclusive, is 293 mm.

TABLE 19.—*Measurements (in millimeters) of first thoracic vertebra of Nothrotherium shastense.*

	No. 1809–2	No. 1809–3	No. 1809–4	No. 1809–5	No. 1809–6
Length of centrum	40.9	42.6	....	....	....
Width of centrum measured over anterior face	44.5	42.4	42.3	41.8	....
Depth of centrum measured over anterior face	25.2	26.7	23.7	27.8	....
Width across metapophyses	96.6	79.7	85.4	86.3	76.2
Greatest width across transverse processes	137.5	132.2	141	139.7	128.3
Length of neural arch along middle and at base of neural spine	56.2	56.9	51.3	....	49.5
Height measured from middle of ventral border of posterior face of centrum to end of neural spine	137.9	141.5	....	[1]131.5	....
Dorso-ventral diameter of neural canal measured at anterior end	23.7	24.9	23.3	21.7	20.5
Transverse thickness of neural spine at middle	14	13.5	15	15.2	13.8
Transverse thickness of end of neural spine	34.2	31.5	....	....	....
Antero-posterior extent of end of neural spine	46	62.9	[1]65	[1]58	....

[1] Approximate.

Thoracic vertebrae.—Six specimens of the first thoracic vertebra (plate 5, figs. 2*a* and 3) of *Nothrotherium* are available for study. In this vertebra the dorsal spine is very broad antero-posteriorly, thus resembling the corresponding element in *Megalonyx* and in *Hapalops*. In the Rancho La Brea specimens the spine is perpendicular, whereas in a first thoracic of *H. elongatus* (No. 15545, Prin. Univ. Coll.), before the writer, the principal axis of the spine is inclined somewhat away from the perpendicular. The large spine in *Nothrotherium*, *Megalonyx*, and *Hapalops* is a remarkable feature and is entirely different from the type of spine in the first thoracic of *Mylodon*.

The centrum, as in the seventh cervical, is relatively shorter when contrasted with that of *H. elongatus*. It is compressed, with dorsal face within the neural arch perforated by large foramina in the middle, and the ventral surface shows similar perforation. Short parallel ridges may be present on the ventral surface, one along the outer side of each foramen as in No. 1809–3, and are probably the remains of the inferior lamellae of the cervical vertebrae. The posterior surface of the centrum is truncated at each dorso-lateral angle by a small articulating facet for the capitulum of the second rib. The anterior zygapophyses are relatively very much smaller than in *Hapalops*, and the transverse processes are also smaller and more slender. Immediately adjacent to each metapophysis is a small canal that pierces the edge of the transverse process and extends

from the anterior to the dorsal surface. Sometimes this canal is open. Viewed from the ventral side (plate 5, fig. 3), the facet for the capitulum of the first rib is seen to be smaller than that for the tubercle. Contrasted with similar facets in *H. elongatus*, those of *Nothrotherium* are relatively smaller and more closely situated. The small facet for the capitulum is situated on the ventral side of the transverse process or along the outer side of the pedicle and does not extend downward along the lateral border of the centrum so far as in the first dorsal of *Mylodon harlani*.

Specimen 1809–4 exhibits an interesting variation in that the metapophysis of the right side is entirely dissociated from the articulating facet for the seventh cervical. Usually the facet is concave and extends upward along the inner side of the metapophysis, but in this specimen the surface extends downward and outward, having an appearance like that in posterior thoracic vertebrae.

TABLE 20.—*Measurements (in millimeters) of thoracic vertebrae of N. shastense, series 1809–1 to 1825–1.*

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13	No. 14	No. 15	No. 16	No. 17
Length of centrum	38	38.9	39.1	39	38.1	40.3	38.7	40.7	41	.....	43.5	43.2	43.9	44.4	44.3	46.3	47.3
Width of centrum measured over anterior face	42	42	40.9	42.3	42.2	43.8	45.2	47	48	[1]50	53.9	56.9	58.6	61.3	65.8	60.5	62.9
Depth of centrum measured over anterior face	24.1	25.6	28.3	31	31.3	33.5	34.5	36.5	38.2	38.5	41.6	42.2	44.1	44.7	46.3	48.2	48.8
Greatest width	.....	.....	113.7	110.5	107.9	105	113.5	115	[1]123.4	126	[1]120	[1]129.2	[1]132.6	[1]132.8	130	130.7	134.2
Length of neural arch along middle at base of neural spine	53.3	.....	49.8	52.3	52.8	53.4	56.9	61	61	.....	61.9	58.2	63.4	60.8	63.7	62	68.7
Height measured from middle of ventral border of posterior face of centrum to end of neural spine	[1]128.6	.....	119	120	119.6	120.1	121.2	124.5	[1]124.5	129.2	134.5	138	140.7	145	151.8	160.4	160.6
Dorso-ventral diameter of neural canal measured at anterior end	21	20.5	21.5	21.8	24	24.8	26.8	26	.....	[1]36	35.2	33.7	35	35.6	35.8	35.8	35.8
Transverse thickness of neural spine at middle	15.5	.....	10.9	10.7	11	10.4	11.9	13.7	12	13.7	14	14.7	13.3	14.7	14.7	14	13
Transverse thickness of end of neural spine	35.4	.....	16.4	15.3	15.7	16.8	19.2	18.9	19.7	22	22	23.6	23.8	24.1	26	25.3	23.6
Transverse width across anterior zygapophyses	.....	[1]57.8	56.1	56.4	56.3	[1]55	59.7	60.6	.....	59.7	60.5	62.1	63.7	66.4	70.4	[1]76.4	78.7

[1] Approximate.

In the thoracic series figured on plate 5, figures 1 and 2, all the vertebrae do not belong to the same individual. Certain changes can be noted, however, in passing from the first to the last of the series. In the third and succeeding vertebrae the tips of the neural spines are much less thickened transversely than in No. 1. In the second vertebra of this series the neural spine has been broken away. In the second thoracic and in the following vertebrae the neural spines slope posteriorly.

Posterior to the second thoracic there is a gradual increase in transverse width across the anterior zygapophyses. The upper facet for the tubercle of the rib is concave in the first to sixth vertebra inclusive. In the seventh it is nearly flat, and in the following vertebrae, to the end of the series, it is convex. From the second vertebra to presumably the ninth inclusive, the dorso-external angle of the posterior face of the centrum is truncated by a small articulating surface for a part of the capitulum of the rib.

The depth of the centrum is fully doubled from anterior to posterior end of the series. In the same distance the length of the centrum increases 24 per cent, while the width of the centrum increases 50 per cent. Throughout the thoracic series the ventral surface of the centrum is pierced on either side of the median line by a foramen. These foramina may become quite large posteriorly and an additional foramen may be added.

Lumbar vertebrae.—The lumbar series in *Nothrotherium* consists of three vertebrae. In *Hapalops* there are three or four vertebrae in this section of the column. There is a slight increase in length of centrum, but a slight decrease in depth from anterior to posterior end of the lumbar series. The width of the centrum increases from the first to third vertebra inclusive. The vertebrae decrease in total height as they approach the sacrum.

The lumbar vertebrae differ from the last thoracic in the development of a forward and upward projecting process having its origin on the upper surface of the base of the transverse process. The process is rather low in the first lumbar, becomes most prominent in the third, meanwhile coming in closer relation with the anterior zygapophysis. In the third lumbar the process is no longer posterior to the anterior zygapophysis, but supports the latter along the inner side of its base. In other words, the anterior zygapophyses now have the major part of their articulating surface directed inward instead of upward.

The base of the transverse process on the right side of the first lumbar is pierced by a canal. The forward-projecting process on this side is also pierced by a rather large foramen near the anterior border.

TABLE 21.—*Measurements (in millimeters) of lumbar vertebrae of N. shastense (series 1826–1 to 1828–1).*

	No. 1	No. 2	No. 3
Length of centrum	49.3	51.5	53.8
Width of centrum measured over anterior face	65.4	70.4	73.9
Depth of centrum measured over anterior face	52.2	52.4	50.7
Width across supports for anterior zygapophyses	85	91.9	57.5
Width across transverse processes	135.7	164.9	147.3
Greatest width across posterior zygapophyses	74	51.8	61
Length of neural arch along middle and at base of neural spine	74.5	[1]64.6	76.6
Height measured from middle of ventral border of posterior face of centrum to end of neural spine	166.7	164.6	159.5
Dorso-ventral diameter of neural canal measured at anterior end	37.9	39	40
Transverse thickness of neural spine at middle	15.5	14.3	16
Transverse thickness of end of neural spine	26.8	30	33.6

[1] Approximate.

Sacral vertebrae.—In both of the more complete specimens of the pelvis of *Nothrotherium* the sacrum consists of five vertebrae. These have been completely united in No. 1892–1, both centra and arches having fused. Dorsally the spines form a continuous crest. In the second specimen the individual centra are still distinguishable. In this the dorsal spine of the fifth or last sacral vertebra has not fused with the spinous crest in front of it.

According to Scott, the sacrum of *Hapalops* consists of five vertebrae, though in some individuals six vertebrae have been noted. The number of sacrals in *Nothrotherium* and in *Hapalops* is thus distinctly less than in *Mylodon*. Close resemblances between the two megalonychids are seen in the structure of the centra and in the union of the sacrum with the os innominatum. As in the sacrum of *Hapalops longiceps*, the middle centra are very much depressed. The nutrient foramina piercing the under sides of the centra tend to disappear in the middle vertebrae of the sacrum. The first three sacral vertebrae join with the ilia, the last two with the ischia.

Caudal vertebrae.—Probably 21 vertebrae were present in the tail of *Nothrotherium shastense* (plate 6). In the most complete caudal series from the asphalt deposits 16 vertebrae are preserved. The first to the fourteenth inclusive form a consecutive series, while the remaining 2 represent the sixteenth and eighteenth vertebrae.

The first caudal vertebra has a short but very broad centrum, with transversely convex anterior face and concave posterior face. The anterior face is not distinct from

the base of the neural arch, as is the posterior face. Consequently the dorsal border of the former is flat, not broadly convex as in the latter. This character is seen also in vertebrae that follow the first. From the first to eighth inclusive the difference between width and height of anterior face of centrum ranges approximately from 30 mm. to 10 mm. From the ninth to the fourteenth inclusive this difference ranges from 8 mm. to approximately 5 mm. In the sixteenth and eighteenth vertebrae the difference is approximately 5 mm.

The neural canal is semicircular when viewed from the front. In posterior vertebrae the roof of the canal may become flatter. The canal is still completely arched in the sixteenth vertebra. In the eighteenth the canal is open dorsally. The neural spine is low and thick in the first segment and gradually decreases in height in those following. It is just barely visible in the eleventh.

TABLE 22.—*Measurements (in millimeters) of caudal vertebrae of N. shastense series 1830–1 to 1847–1.*

	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13	No. 14	No. 16	No. 18
Length of centrum.....	51.3	50.2	48.9	47.5	48.4	48.3	48.2	48.9	47.9	46.3	44.6	42	39.3	35	33	27.3
Width of centrum measured over anterior face.	74.1	70.7	68.4	64.6	61.4	59	56	51.6	47.6	45.2	41.6	39.9	36.6	33.9	31	27.3
Depth of centrum measured over anterior face..	44.7	49	49.9	49.7	47	45.3	43.5	41	39	38	34.7	34	30.8	29	25.9	21.5
Greatest width across metapophyses.....	89.5	90.5	87.5	78.3	70.8	66.3	60.5	55.6	52.5	48.5	38.9	25.3	22	21.6	19.2	.....
Width across transverse processes.....	214.7	212	176.4	154.2	154.3	144.9	145.3	137.3	125.5	111.9	92	76.5	68.8	59	51.6	41.7
Greatest antero-posterior diameter of transverse process.....	39.7	44.5	38	41.9	36.3	34.7	39.8	41.5	40.4	36.8	34.8	32.4	29.3	22.3	21.4	15.3
Greatest width across posterior zygapophyses....	55.8	53.3	48.7	43.8	46	46.2	45.2	44.3	42.3	32.3	21.7	16.2	12.8	16	13.6	.....
Height measured from middle of ventral border of posterior face of centrum to end of neural spine.....	97.2	89.7	84.6	81	77.9	72.7	66.9	62.8	56	52.8	46.5	41	37.6	37.3	28.7	.....

The anterior and posterior zygapophyses in the anterior 11 vertebrae project in front and in back of the centrum respectively. In the eleventh segment they reach only to the limits of the anterior and posterior faces. In the first vertebra the anterior zygapophysis is inclined steeply inward and is relatively narrow antero-posteriorly. In following vertebrae the facet becomes wider. In the seventh and following vertebrae the facet becomes less steeply inclined and ultimately comes to face distinctly upward. The facet is functional to and including the eleventh vertebra. The posterior zygapophyses are first steeply inclined and face directly outward, but in following vertebrae the facets are gradually directed more downward as well as outward. Commencing with the eighth vertebra and proceeding backward, the posterior border of the neural arch between the posterior zygapophyses is decidedly notched.

The transverse process is long in the first two vertebrae and much shorter in the third of the series and posteriorly. In the second segment it differs from that in the first in having the outer border deflected dorsally. A distinct flange is found along the posterior border of the process in the second, an indication of which is already present in the first caudal. In the third vertebra the flange is transformed into a process and the outer border is relatively thick. From the fourth to the thirteenth vertebra inclusive a defined downward deflection occurs which reaches its maximum extent in the seventh vertebra. The metapophysis of the first segment is short antero-posteriorly. It is low and heavy, decreasing in size in following vertebrae.

On each side of the ventral surface of the centrum and connected with the anterior border, but separated from the posterior by a deep channel, is a knob-like prominence. This is connected dorsally with the transverse process. Opposite these prominences and on the posterior border are two facets articulating with the chevron-bone. In the second vertebra the anterior pair of chevron facets occupies a position comparable to the position of the knob-like prominences of the first caudal. The posterior pair of chevron facets is smaller than the anterior pair. The latter difference between the two pairs of facets is found also in the third vertebra. In the fourth and fifth vertebrae the two pairs are of nearly equal size, while in the sixth to ninth inclusive the posterior pair is decidedly the larger. From the tenth vertebra posteriorly the anterior pair of facets is absent, while the posterior pair disappears in the twelfth. The interspace between right and left sets of chevron facets becomes narrower from the first vertebra posteriorly. In the first segment this area is perforated by two large foramina. In those following the usual number is either 2 or 4.

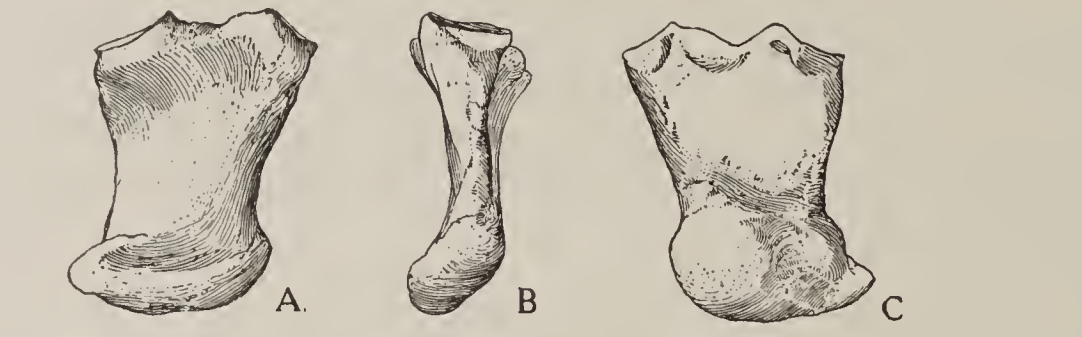


FIG. 16.—*Nothrotherium shastense* Sinclair. *A*, *B*, *C*, outer, anterior, and inner views of right half of second haemapophysis, No. 1919-R-1; *D*, *E*, *F*, outer, anterior, and inner views of right half of fourth haemapophysis, No. 1921-R-1. × 0.50. Rancho La Brea Pleistocene.

HAEMAPOPHYSES.

The available haemapophyses or chevron-bones of *Nothrotherium* pertain principally to the forward and middle regions of the tail. Associated with the most complete caudal series of vertebrae from Rancho La Brea are 5 haemapophyses. The material belonging to this individual consists of the following specimens:

(1) Right half of second haemapophysis articulating with second and third vertebrae (fig. 16, A, B, C).
(2) Right half of fourth haemapophysis articulating with fourth and fifth vertebrae (fig. 16, D, E, F).
(3) Complete fifth haemapophysis articulating with fifth and sixth vertebrae (fig. 17, A to E).
(4) Complete sixth haemapophysis articulating with sixth and seventh vertebrae (fig. 18, A, B).
(5) Complete ninth haemapophysis articulating with ninth and tenth vertebrae (fig. 19, A, B, C).

The haemapophyses of *Nothrotherium* differ strikingly in shape from those of *Hapalops*. In the anterior portion of the tail, the elements when completely formed by fusion of the right and left pieces are more X-shaped than Y-shaped. They are Y-shaped in *Hapalops* and in *Mylodon*. As a descriptive term the designation "chevron" is therefore not truly applicable to the ventral appendage of the caudal vertebra in *Nothrotherium*. In the anterior four haemapophyses the two lateral pieces are not united, for the facets on the caudal vertebrae articulating with these elements are widely sepa-

rated transversely. Including and posterior to the fifth haemapophysis, the two parts have united in median line. This union usually takes place at about the middle of the element and may or may not extend completely to the distal end.

In the series available the haemapophyses increase in depth from the most anterior element to at least the sixth. Posterior to the latter the decrease in depth is apparently rapid. When right and left parts of a single haemapophysis are joined in middle line, the proximal arms of the X inclose an oval-shaped trough. Each arm bears an anterior and a posterior facet for the vertebral centra with which it articulates. In the first and second haemapophyses the posterior facet is the larger, and in the third the anterior and posterior facets are approximately of same size. In the haemapophyses behind

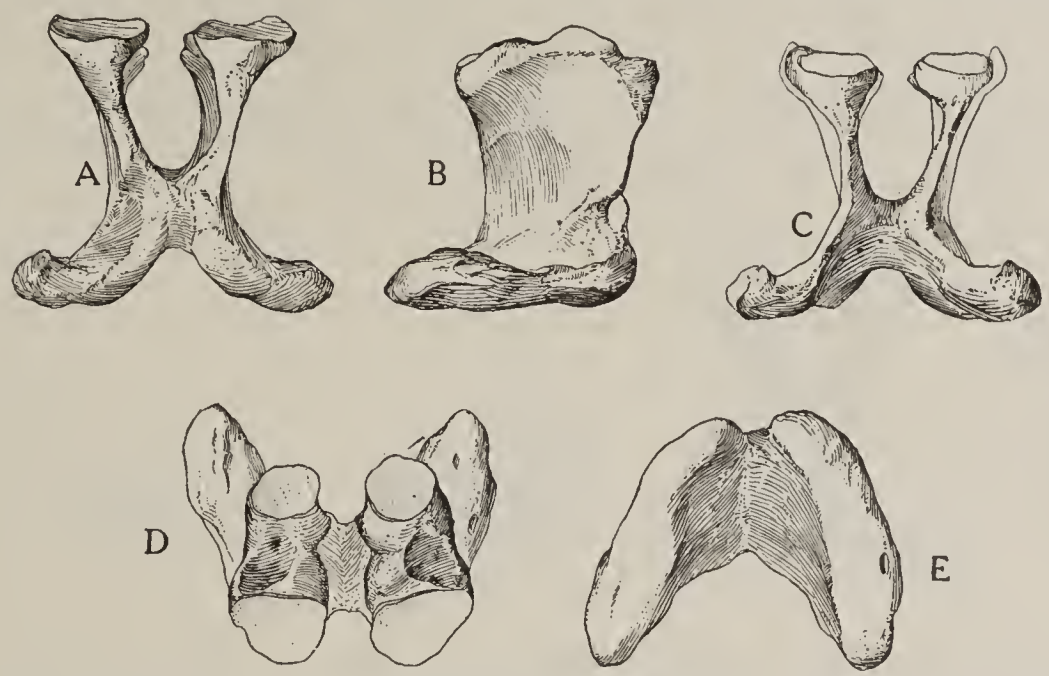


FIG. 17.—*Nothrotherium shastense* Sinclair. Fifth haemapophysis, No. 1922-1. × 0.50. *A*, anterior view; *B*, outer view; *C*, posterior view; *D*, dorsal view; *E*, ventral view. Rancho La Brea Pleistocene.

and including the fourth, the anterior facet is the larger and lingers after the posterior one has disappeared. The ninth haemapophysis is much reduced in dorso-ventral extent and bears two large vertebral facets anteriorly, but only two tubercles posteriorly. The distal surface of this element is broad and the haemal canal is relatively large.

In the fifth and sixth haemapophyses, where the two halves are present and united, the lower or distal arms of the X are not only divergent from their median union, but flare also posteriorly. In other words, the two distal arms of the X are not parallel in their antero-posterior extent, as are the proximal arms. In the five haemapophyses listed above, the distal arm is shortest in antero-posterior extent in the second and

TABLE 23.—*Measurements (in millimeters) of haemapophyses of N. shastense.*

	No. 1919–R–1 2	No. 1921–R–1 4	No. 1922–1 5	No. 1923–1 6	No. 1926–1 9
Greatest depth	57.9	56.2	55.1	64.1	29.8
Greatest transverse width at proximal end	....	....	48	48.5	28.7
Least transverse width	....	....	24.2	20.7	....
Greatest transverse width at distal end	....	....	62.7	[1]61	16.4
Greatest antero-posterior length of proximal right limb	43	43.7	39.8	40.6	32.4
Least antero-posterior length of right side of haemapophysis	28.2	28.3	27.3	28.4	....
Greatest antero-posterior length of distal right limb	39	58.4	53	[2]49.5	....
Thickness of proximal end of right limb	24.4	23.8	20.1	21.3	12.6

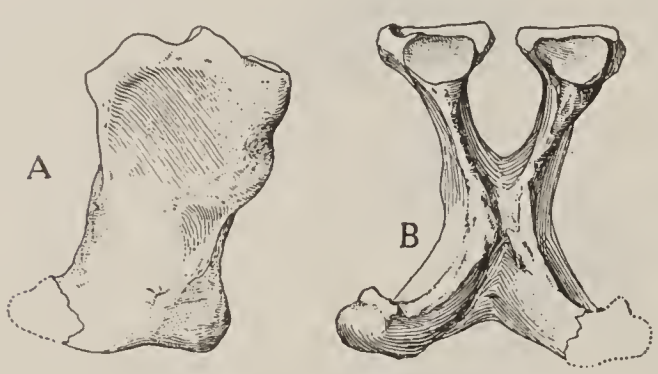
[1] Approximate. [2] Left side.

longest in the fourth. In several haemal elements of *Nothrotherium* from Rancho La Brea, a canal extends through the fused median portion of the bone, reaching from the haemal trough to between the diverging lower arms.

The peculiar shape of the haemapophyses in *Nothrotherium* is quite different from that seen in other gravigrade edentates. It suggests a fleshy and massive tail. A great development of caudal musculature is probably also indicated by the large size of the principal caudal blood-vessel inferred from the capaciousness of the haemal canal.

COSTAL RIBS.

A number of costal ribs (plate 7, fig. 2) accompany the thoracic vertebrae from Pit 3. In this series the first is fused with the sternal rib. In the second rib the articulating face of the head is flat, while that of the tubercle is transversely concave. The latter facet encroaches upon the posterior face of the rib. In the fourth rib the facet of the tubercle is slightly convex, while that of the head is still flat. The tubercle is prominent to about the ninth rib. In this region the articulating facet begins to sink into the shaft and the tubercle is reduced. Distal to the tubercle the shaft in the first



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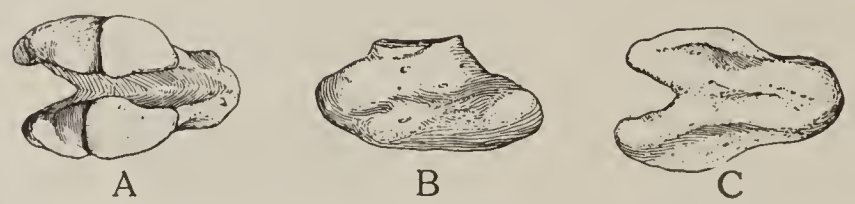

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Fig. 18.—*Nothrotherium shastense* Sinclair. Sixth haemapophysis, No. 1923-1. × 0.50. *A*, outer view; *B*, posterior view; Rancho La Brea Pleistocene.

Fig. 19.—*Nothrotherium shastense* Sinclair. Ninth haemapophysis, No. 1926-1. × 0.50. *A*, dorsal view; *B*, outer view; *C*, ventral view. Rancho La Brea Pleistocene.

and second ribs is quadrilateral in cross-section. In the two ribs which follow, the shaft begins to broaden antero-posteriorly. The tenth, eleventh, twelfth, and thirteenth ribs are wide, while the last four ribs are relatively thick.

STERNAL RIBS.

The sternal ribs (plate 7, fig. 1) in *Nothrotherium* resemble those typically developed in ground-sloths and lend strength to the ventral side of the rib-basket. There were presumably 10 ossified sternal ribs on each side of the sternum, a number comparable to that found in other Pleistocene genera. The anterior 8 joined the costal ribs to the sternum, while the ninth connected with the eighth and the tenth with the ninth. The first sternal rib commonly fuses with the costal rib, and such fusion may occasionally occur in the second. In *Mylodon harlani* and in *Megatherium* apparently only 7 sternal ribs articulate directly with the sternum. The complete series is not known in *Megalonyx* or in the Upper Miocene megalonychids from Patagonia.

The first sternal rib is plate-like and of trapezoidal shape. It articulates by a narrow elongate facet with the side of the manubrium. The dorso-ventral extent of this rib is greater than the transverse diameter.

The second and third sternal ribs are not definitely known. In the nearly complete series from Pit 3 a sternal rib is present which possibly represents the second. It apparently joined only with the ventral keel of the sternal segment, for an articulating surface more dorsally situated is not present in this specimen as in posterior ribs. In this respect the specimen under observation would probably answer best to the second,

for in the union of the second and first sternal segments there is no dorsal facet for the second sternal rib. The rib possesses, however, an antero-internal articulating surface, while no comparable facet is found on the manubrium. The shaft of the rib is compressed antero-posteriorly. Toward the union with the costal rib the shaft widens and deepens.

TABLE 24.—*Measurements (in millimeters) of costal ribs of N. shastense, series 1850–1 to 1866–1.*

	Distance across head and tubercle.	Dorso-ventral diameter of head.	Greatest transverse width of shaft.	Length along greater curvature from facet of tubercle to distal end.
No. 1.....	36	11.4	....	150
No. 2.....	40.5	14	....	....
No. 4.....	[1]42.4	....	29.6	....
No. 5.....	....	....	35	280
No. 6.....	53.7	17.8	37.4	330
No. 7.....	59.7	21	[1]38	370
No. 8.....	61	24.7	[1]34.8	390
No. 9.....	61.6	24.6	35	405
No. 10.....	63.3	24.6	35.3	410
No. 11.....	63	23.9	35.2	....
No. 12.....	62.7	23.7	35.4	....
No. 13.....	66	23.3	39.4	....
No. 14.....	64	23.9	38.9	440
No. 15.....	65.5	22.7	36.3	[1]410
No. 16.....	66.3	20.7	32.5	400
No. 17.....	65.1	19.6	32.4	[1]360

[1] Approximate.

The fourth sternal rib (No. 1905–L–1) is relatively thin and has a warped appearance, the median half extending in dorso-ventral direction, the lateral half reaching more in an antero-posterior direction. The ventral surface of the lateral half is concave. At the middle of the posterior border of the lateral half this rib was attached to the fifth sternal rib. A connection between the fourth and fifth sternal ribs is not known to occur in *Mylodon* or in *Megatherium*. The lateral extremity is expanded for cartilaginous connection with the costal rib. The medial articulation of the fourth rib with the sternum consists dorsally of a single facet, which joins with the dorsal portions of the third and fourth sternal segments. Ventrally the articulation consists of two facets, one joining with the ventral head of the third sternal segment, the other with the ventral head of the fourth sternal segment. The facets extend well to the anterior and posterior sides of the medial extremity of the rib.

The fifth sternal rib (No. 1906–L–1) resembles the fourth, but is longer. It bears along the anterior border a facet for the fourth rib which is directed downward and forward. The rib is relatively thin and the ventral crest lies along the posterior border. The vertebral end is expanded and divided into two parts, one of which is directed anteriorly and connects with the costal rib, while the other is directed posteriorly and joins with the sixth sternal rib.

The sixth sternal rib (No. 1907–L–1) does not possess the warped appearance of the fourth and fifth, but the dorsal part of the shaft has broadened to form a distinct base, from which is subtended a sharp ventral crest. The latter reaches from the head to a point where the medial two-thirds and lateral one-third of the shaft meet. The lateral one-third of the shaft carries a contact-surface on the anterior border for the fifth sternal rib. The vertebral end joins in part with the costal rib and in part with the seventh sternal rib.

The seventh sternal rib (No. 1908–L–1) is heavier than the sixth, although the medial head is no larger than that of the latter rib. The ventral crest which extends at first along the middle of the shaft moves to the anterior border as the vertebral extremity is approached. Here it carries an oval surface for the sixth sternal rib. Posterior to this ridge the rib widens into a thin plate, but much of this and practically all of the lateral extremity have been broken away in the specimen under examination. There is a distinct upward curvature to the lateral portion of the dorsal surface and a forward bending of the anterior border. The medial extremity articulates with the sixth sternal segment and the xiphisternum.

The eighth sternal rib (No. 1909–R–1) also articulates with the sternum, in which respect *Nothrotherium* differs from *Megatherium* and *Mylodon*. The shaft is much curved. The medial extremity is tumid, with antero-posterior diameter smaller than that in any of the four preceding ribs. The head bears medially a flattened facet, and above this a small surface, both of which apparently articulate only with the xiphisternum.

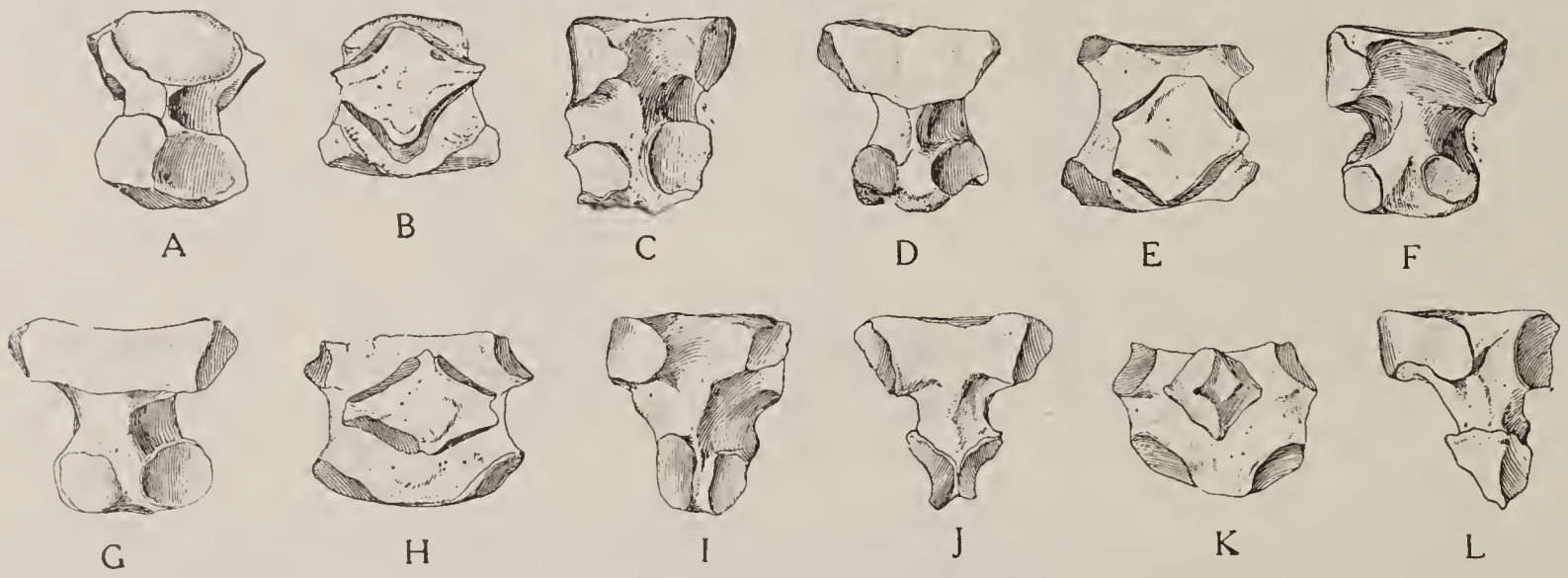

FIG. 20.—*Nothrotherium shastense* Sinclair. Sternal segments; anterior, ventral, and right side views. × 0.50. *A*, *B*, *C* second segment, No. 1896-1; *D*, *E*, *F*, third segment, No. 1897-1; *G*, *H*, *I*, fifth segment, No. 1899-1; *J*, *K*, *L*, sixth segment, No. 1900-1. Rancho La Brea Pleistocene.

The ninth sternal rib (No. 1910–R–1) unfortunately lacks the medial stem. It is broad, flattened, and plate-like where it joins with the costal rib, but tapers inward towards the stem. The surface for attachment to the costal rib cuts obliquely across the outer anterior corner of the sternal rib.

The tenth sternal rib (No. 1911–L–1) also lacks the medial stem. This rib is short, considerably flattened, thin, and tapers towards the medial end. The surface of attachment to the costal rib is comparable in position to that in the ninth sternal rib. The difference in size between this specimen and the ninth rib is probably no greater than that between the corresponding ribs of *Megatherium*.

STERNUM.

The sternum (plate 7, fig. 1; also fig. 20, A to L) has not been found completely preserved in any one individual from the asphalt deposits, but the number of elements available furnish some information regarding this structure. Presumably the sternum of *Nothrotherium* consists of 7 segments, a number comparable to that in other Pleistocene ground-sloths.

The dorsal or internal surface of the sternum is flattened, or may be slightly concave transversely in mid-region. Behind the manubrium the individual segments increase gradually in width to the posterior end of the fourth, when a decrease in width takes place. The mesosternal elements are compact and pawn-like in appearance. They are constricted laterally and, in contrast to those of *Mylodon*, do not have the ventral

head or keel so elongate in antero-posterior direction. This is particularly true of the second, third, and fourth sternal segments. All the elements articulate laterally with the heads of the sternal ribs. Those of the mesosternum possess for this articulation 4 facets on each side, 2 supported by the ventral process and 1 situated at each angle and on the under side of the dorsal plate.

The manubrium approaches the triangular shape, with anterior end tapering. It differs from that in *Hapalops* in lacking a large forward process. The dorsal surface is for the most part smooth and concave. In *Hapalops* the dorsal concavity is much deeper than in *Nothrotherium*. Immediately behind the anterior projection the manubrium possesses the greatest dorso-ventral diameter. The posterior half of each lateral margin supports a large and a small facet for the first sternal rib.

TABLE 25.—*Measurements (in millimeters) of sternal elements*[1] *of N. shastense.*

	Manubrium No. 1876-1	Manubrium No. 1876-2	Manubrium No. 1876-3	Second segment No. 1896-1	Third segment No. 1897-1	Fourth segment No. 1898	Fifth segment No. 1899-1	Sixth segment No. 1900-1
Greatest length through middle...	80.5	95.6	89.4	....	....	....	....	....
Greatest width.....	69.2	82	67.7	....	....	....	....	....
Greatest thickness.....	31.3	36	30.3	....	....	....	....	....
Width of facet for second sternal segment.....	33	31	27	....	....	....	....	....
Greatest length of dorsal plate...	....	....	....	32.5	35.4	43.2	34.4	29.9
Greatest width of dorsal plate at posterior end.....	....	....	....	35.8	[2]38.5	52.8	41.9	39
Greatest depth.....	....	....	....	36	35.8	38.8	37.9	37.4
Antero-posterior diameter of ventral process.....	....	....	....	27.6	26.2	31.4	19.2	15.8
Transverse diameter of ventral process.....	....	....	....	30.1	26.3	35.1	30.8	19.1

[1] Mesosternal elements from several individuals. [2] Approximate.

At the middle of the posterior margin is a wide facet articulating with the second sternal segment. This surface is concave transversely and may be incompletely divided into two parts by a median notch, as in No. 1876–4. In five specimens from Rancho La Brea the facet varies considerably in width. In the manubrium of *Mylodon harlani* the articulating surface for the second sternal segment is directed posteriorly and the ventral surface of the first element lies, therefore, in practically the same plane as that of the mesosternal series. In *Nothrotherium*, however, the comparable facet of the manubrium is directed for the most part not posteriorly, but decidedly more to the dorsal side, as in *Hapalops elongatus*, and indicates that the first segment is sharply deflected from the sternal series behind it. In *Megatherium americanum* the posterior articulating surface is also directed more to the dorsal side, much as in *Nothrotherium*, although it differs in shape.

The second sternal segment differs from that in *Mylodon* in possessing a single articulating surface for the manubrium, namely, along the anterior side of the dorsal plate. In other words, there is no connection between the ventral process and the element in front. The third sternal segment is relatively long. Both 2 and 3 increase in width toward the posterior end. The fourth sternal segment is shorter than the third, but relatively broader transversely.

CLAVICLE.

The clavicle (plate 8, fig. 4) is similar in appearance and in curvature to that of *Mylodon*. The shaft is fairly uniform in width, but the sternal extremity is expanded and relatively heavy.

SCAPULA.

Three or four nearly complete scapulae (plate 8, figs. 3, 3*a*) of *Nothrotherium* are available. These specimens are strikingly similar on the whole to the shoulder-blade in *Hapalops*. The spine is high and, as in the Miocene genus, divides the outer face into a large prescapular fossa and a much smaller postscapular fossa. In *Megalonyx*, according to Leidy (1855, p. 25), "the dorsum (Pl. VIII, Fig. 1), as in *Mylodon*, is nearly equally divided by the spine into two deeply concave fossae, which are roughened with reticular ridges." On the inner surface of specimen 1868–R–2 there are two concavities, the larger and broader being below the prescapular fossa, while the smaller is below the postscapular fossa. The surface is marked by several longitudinal ridges and reticulations.

TABLE 26.—*Measurements (in millimeters) of clavicle of N. shastense.*

	1878–R–2	1878–R–4
Greatest length	140.6	[1]136.2
Greatest width of outer end	20.3	....
Greatest width at middle of shaft	18.2	17.5
Thickness at middle of shaft	11.5	9.2
Greatest width of sternal end	[1]32.8	37.3
Thickness of sternal end	24.6	20

[1] Approximate.

The spine is connected anteriorly with the coracoid by the coraco-acromial arch. In the extent to which the arch projects below the glenoid cavity *Nothrotherium* appears to be more like *Hapalops* than like *Choloepus*. It differs from *Hapalops* in having a broader coracoid portion. In the region of its greatest width the arch is relatively wider than in *Megalonyx*. Along the lower portion of the inferior border of the arch there is a prominent knob-like projection which bears on the anterior side an articulating surface for the clavicle. In the scapula (1868–L–3) of a young individual that portion of the acromion which possesses the facet for the clavicle is lacking. The appearance of the end of the scapular spine and of the end of the coracoid to which the acromial arch ordinarily joins leads one to believe that the intervening piece ossifies separately and only in the mature animal does it fuse completely with the adjacent structures to form the acromial arch. The coraco-scapular foramen is oval in shape, with the long axis extending dorso-ventrally.

TABLE 27.—*Measurements (in millimeters) of scapula of N. shastense.*

	No. 1868–R–1	No. 1868–R–2	No. 1868–L–1	No. 1868–L–3
Length from superior border of glenoid cavity to suprascapular border and along the spine	[1]246	[1]236	[1]234	[1]234.5
Length from calvicular facet to suprascapular border, measured along spine.	....	[1]311	[1]304.5	....
Greatest width of blade, measured between ends of suprascapular border..	....	[1]272.7	[1]250.4	[1]249.6
Width measured below base of spine	149.8	144.3	128.7	142.5
Height from middle of inferior border of glenoid cavity to point directly above on surface of acromian process	[1]95	100	[1]90.5	[1]97
Greatest antero-posterior diameter of glenoid cavity	71	70	74	73.7
Greatest transverse diameter of glenoid cavity	45.3	49.7	48	50.3
Greatest width of coraco-acromial arch	....	61.4	[1]54.8	....
Greatest diameter of coraco-scapular foramen	31.7	....	....	29.7

[1] Approximate.

It may be relatively large in some specimens, being comparable in size to the foramen in the much larger scapula of *Mylodon harlani*.

In none of the specimens is the coraco-scapular suture visible. The extent of the coracoid anterior to the coraco-scapular foramen is relatively as great as in the scapula of *Hapalops*. In specimen 1868–L–3, although the suture between coracoid and scapula has become obliterated, the epiphysis forming the glenoid cavity is still distinct. The glenoid epiphysis exists separate from the coracoid, as in *Megalonyx jeffersonii*, but there is no indication of a division of this epiphysis into two parts, as in the former. The glenoid cavity is broadest opposite the base of the spine and narrows anteriorly.

HUMERUS.

Several specimens in the collections of the Los Angeles Museum represent the upper arm-bone of *Nothrotherium* (plate 8, figs. 1, 1*a*, 2, 2*a*). These include a complete humerus (No. 1874–R–1) and a larger specimen (No. 1874–R–2), without proximal tuberosities and head, and evidently belonging to an older individual than the former. There are also two specimens belonging to young individuals in which the epiphyses are absent.

TABLE 28.—*Measurements (in millimeters) of humerus.*

	Nothrotherium shastense, No. 1874–R–1	Nothrotherium shastense, No. 1874–R–2	Hapalops sp., No. 15532, Prin. Univ. Coll.	Hapalops longiceps (after Scott).
Greatest length	432.4	....	179	192
Width at proximal tuberosities	106.2	....	50.8	....
Width of shaft at middle	55.3	67.8	27	....
Least width of shaft	50.3	55.6	19.8	....
Thickness of shaft at end of deltoid crest	39	49.3	29.8	....
Greatest width of distal expansion	168	[1]192.4	73.5	79
Width of distal trochlea	95.9	109.6	39.4	44

[1] Approximate.

The striking difference between the humerus of *Nothrotherium* and that of *Megalonyx* is the more slender construction of the element in the former genus. Although No. 1874–R–1 is but a trifle shorter than the humerus, No. 21003 U. C. C., of *Megalonyx* (compare with plate 19, figs. 1, 1*a*, 1*b*, 2), and shorter than specimens of *M. jeffersonii* described by Leidy, the shaft is comparatively slender and the distal third much less expanded. *Nothrotherium* differs more from *Hapalops* in slenderness of shaft of humerus than does *Megalonyx*. In anterior view the head of the humerus does not appear as prominent as in the Miocene genus and the tuberosities are not separated so much and are not quite so prominently developed. A difference between the upper arm-bone of *Nothrotherium* and that of *Megalonyx* from Rancho La Brea is seen in the deep groove which separates the lesser tuberosity from the head and extends outward and in front of the head. This groove is also absent in the humerus of *Hapalops*. Between the greater tuberosity and head no deep gutter exists, but the slight groove which is present is more distinct than in the humerus of *Megalonyx*. Anterior to the middle of the head the tuberosities are connected by a broader shelf than in *Megalonyx*.

A deep groove extending parallel to the shallow bicipital groove is present on the anterior face of the lesser tuberosity. This channel is lacking in the humerus of *Megalonyx*. No deep groove is present in the humerus of *Hapalops* available for comparison, but in the specimen a broad, shallow groove or depression extends obliquely downward and across the anterior surface of the lesser tuberosity from its upper border.

In No. 1874–R–1 the pectoral and deltoid ridges are but feebly developed, while in an older individual (No. 1874–R–2) they become more rugose. In neither of the

two specimens from the asphalt beds do the ridges meet below in such a decided eminence as in *Hapalops*. This eminence is also of less height than in the humerus of *Megalonyx*. In the Miocene genus the pectoral ridge extends as a very pronounced crest along the anterior face of the humerus from between the proximal tuberosities, while in *Nothrotherium* (No. 1874–R–1) it is slightly closer to the inner border of the shaft and is by no means so prominent. In a specimen from Hawver Cave (Stock, 1918, p. 504, figs. 24*a*, 24*b*) the pectoral ridge forms the antero-internal border above the middle of the shaft. The deltoid ridge in the young individual is very little developed and the musculo-spiral course is hardly outlined, while in a mature form (No. 1874–R–2) these structures are much better indicated. The shaft in the older individual is more subquadrate or trapezoidal in cross-section.

The distal portion of the humerus in *Nothrotherium* is relatively not so expanded transversely as it is in that of *Megalonyx*. The internal tuberosity is not so massive as in the latter genus. An entepicondylar foramen is present, as in *Hapalops* and *Megalonyx*. The bar over this foramen is slender. The ulnar articulation surface of the distal trochlea differs from that in *Megalonyx* in being approximately flat transversely and in sloping downward and inward, reaching a point at or slightly below the level of the radial articulation. It is, however, distinctly convex antero-posteriorly, as in *Megalonyx*. The radial surface is relatively smaller and the trochlea not thick antero-posteriorly, as in *Hapalops*. The olecranon fossa resembles that in the humerus of *Hapalops* and is deeper than in the specimen of *Megalonyx* from Rancho La Brea.

TABLE 29.—*Measurements (in millimeters) of ulna of N. shastense.*

	No. 1873–R–1	No. 1873–L–1	No. 1873–L–2	No. 1873–L–3	No. 1873–L–4
Greatest length	....	448.3	442.5	....	....
Greatest width from summit of coronoid process	94.3	93.5	92	94.6	83
Width of shaft at middle	50.5	44.8	45.5	....	....
Thickness of shaft at middle	34.1	31	30.9	....	....
Greatest width of shaft at distal end	....	43	44.8	....	....
Thickness of distal articulating surface	....	31.7	40	....	....
Distance from summit of coronoid process to end of olecranon	122	114	124.8	114.5	105

ULNA.

The ulna (plate 9, figs. 1, 2, 3) differs decidedly from that of *Megalonyx* in the much less antero-posterior diameter, but noticeably greater transverse thickness of shaft. The element thus resembles the ulna of *Hapalops* more in lateral view. It lacks, however, the distinct sigmoid curvature which the latter possesses, and does not have so prominent an olecranon. The latter process is very short in the Pleistocene genus and is expanded in transverse direction. Such expansion of the olecranon is absent in the ulna of *Hapalops*, according to Scott. The coronoid process is prominent in the ulna of *Nothrotherium*. A line drawn through this process and through the posterior end of the sigmoid notch forms an acute angle with the main axis of the bone. In the ulna of *Hapalops* a corresponding line is nearly parallel to the main axis.

A difference from the ulna of *Megalonyx* is seen in the absence or small development of the surface articulating with the radius. In its place there is sometimes a deep depression. The outer surface is plane or concave, and in specimen No. 1873–L–1 is marked by reticular ridges. The distal articulating surface is semioval, concave, and is relatively not so extensive as that of *Megalonyx*.

RADIUS.

The radius (plate 9, figs. 4, 5) is not represented by complete material, but the specimens available supply information for all parts of the element. The lower two-thirds

in one specimen from Rancho La Brea is relatively more slender than that in the radius of either *Hapalops* or *Megalonyx*. The shaft of the radius is strongly curved. The bicipital tubercle is large as in *Hapalops* and placed on the posterior side of the shaft. It is not as prominent as in *H. longiceps* and is situated relatively not so far below the head as in that species. In its proximal and distal thirds the posterior surface of the shaft is convex, while the middle third is flatter. In No. 1872–R–1 the latter surface is marked by a number of reticular ridges. The anterior face of the shaft is also

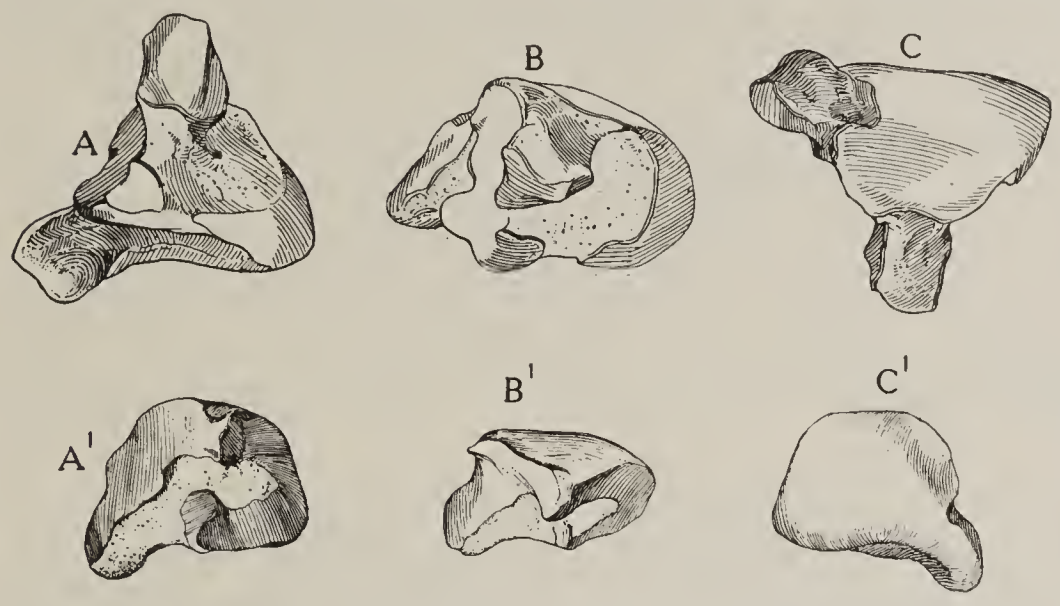

FIG. 21.—*Nothrotherium shastense* Sinclair. Left scaphoid, No. 1944-L-1. *A*, distal view; *B*, dorsal view; *C*, proximal view. × 0.50. Rancho La Brea Pleistocene.

Hapalops sp. Left scaphoid, No. 15171 P. U. C. A^1, B^1, C^1, same views as in *A*, *B*, *C*. × 1.0. Santa Cruz Miocene.

roughened and is traversed obliquely in the lower half by a broad groove. The surface which articulates with the humerus is oval in shape and moderately concave. The facet for the ulna is not large, the radius thus resembling that of *Hapalops*.

The distal extremity is wide and thick. It bears an undivided carpal facet which is concave, widest at the ulnar border, and descending to the styloid process. It is of greater antero-posterior extent toward the inner side than that in the radius of *Megalonyx*.

TABLE 30.—*Measurements (in millimeters) of radius of N. shastense.*

	No. 1872–R–1	No. 1872–L–1
Greatest length	[1]415	....
Width at middle of shaft	52	44.6
Thickness at middle of shaft	30.8	21.6
Greatest width of distal end	78.5	....
Greatest thickness of distal end	56.7	....
Greatest width of proximal end	....	48.9
Greatest thickness of proximal end	....	44.6

[1] Approximate.

SCAPHOID.

The scaphoid of *Nothrotherium* is known by two specimens from the Pleistocene of California; the first specimen, No. 1944–L–1 (fig. 21 A, B, C) from Rancho La Brea and in the collections of the Los Angeles Museum, the second specimen, No. 9437, Univ. Calif. Coll., from Samwel Cave.

The scaphoid of *Nothrotherium* is decidedly smaller than that of *Megalonyx jeffersonii* and is also smaller than that of *M. sierrensis* (W. J. Sinclair, 1905, plate 20, figs. 7 and 8). In proximal or radial view (fig. 21 C), the scaphoid differs noticeably from that of *M. jeffersonii* in shape and in the relatively smaller extent of the radial surface. At the

outer dorsal side there is a more pronounced extension of the scaphoid than in *M. jeffersonii*. The element in *M. sierrensis* is somewhat more like that of *Nothrotherium* than is *M. jeffersonii*, but also lacks the conspicuous projection of the outer dorsal border.

The outer dorsal projection of the scaphoid is much better developed than in *Hapalops* (fig. 21, compare A, B, C with A^1, B^1, C^1), the latter form being in this respect more like *Megalonyx*. The distal surface of this process in *Nothrotherium shastense* (fig. 21 A) is sigmoid transversely and articulates with the magnum. It is bordered on its outer side by a small facet for the lunar. Along the inner side it is continuous with, but also separated by a sharp angle from, an elongate facet for the trapezoid, as in *M. jeffersonii*.

TABLE 31.—*Measurements (in millimeters) of scaphoid of N. shastense.*

	No. 1944–L–1 L. A. M.	No. 9437 U. C. C.
Greatest dorso-palmar diameter	49.5	49.2
Greatest transverse diameter	54.5	51.7
Greatest proximo-distal diameter	34	32

The facet for the trapezoid in the specimen from Rancho La Brea extends to the palmar border, where it lies adjacent to a small flat articulating surface for the magnum. In the scaphoid of *Nothrotherium* from Samwel Cave the surface for the trapezoid is divided into two parts. In *Hapalops* (fig. 21 A^1) a second small facet for the trapezoid is situated close to the palmar border. The absence of a distinct articulating surface for the magnum on the scaphoid of *Hapalops* permits the dorsal trapezoid facet and the lunar facet to meet in a ridge. The dorsal surface for the magnum is well developed in both *Nothrotherium* and *Megalonyx*. In *M. jeffersonii*, as shown by Leidy (1855, plate 8, fig. 7), there is present a second facet for the magnum close to the palmar border and separated from the first facet for the magnum by a transverse gutter. The presence of a palmar facet for the magnum is seen also in the scaphoid of *Nothrotherium* from Rancho La Brea, but it is not clearly indicated in the specimen from Samwel Cave.

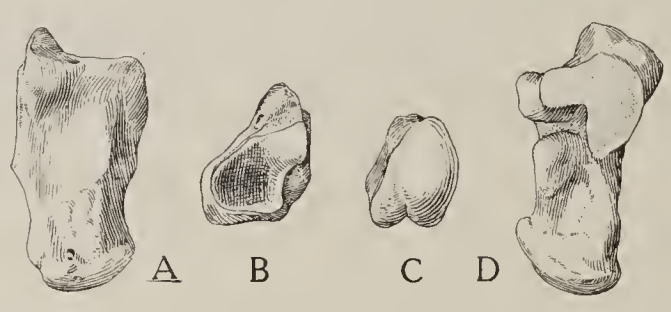

FIG. 22.—*Nothrotherium shastense* Sinclair. Right trapezium and metacarpal I, Nos. 1912-R-I, 1913-R-1. *A*, dorsal view; *B*, proximal end; *C*, distal end; *D*, inner view. × 0.50. Rancho La Brea Pleistocene.

The facet for the trapezium is relatively smaller than in *Hapalops*. It is less extensive in the specimen from Rancho La Brea than in that from Samwel Cave. As will be shown below, the trapezium in *Nothrotherium* may join with metacarpal I to form a single element and does not unite, therefore, with the scaphoid. There is reason for believing that a similar union occurs in *Megalonyx* and the inner proximal carpal element should not be designated "scaphotrapezium."

TRAPEZIUM AND METACARPAL I.

Only one specimen of a trapezium of *Nothrotherium* is known from the asphalt deposits, and it is fused with metacarpal I to form a single element (fig. 22, A to D). Such fusion commonly occurs in the manus of *Mylodon*, but the two elements are separate in a small number of mylodont forms from Rancho La Brea. The presence in the collections from the asphalt of a single metacarpal I, (No. 1912–L–1) of *Nothrotherium* indicates also that the trapezium and the first metacarpal are not always joined in this genus. In the individual of *Nothrotherium* described by Winge (see p. 78, fig. 28),

the trapezium and the first metacarpal are fused and this element is in articulation with the scaphoid. In the manus of *Hapalops* the two elements are not united, and presumably the separation is the usual occurrence in the Miocene genus. The trapezium in this genus articulates with the side of the second metacarpal.

At the proximal end of the trapezial portion of the compound element (No. 1912–R–1, 1913–R–1) is located a narrow articulating surface, elongated in dorso-ventral axis, somewhat constricted at the middle, and deeply concave. The facet joins with the scaphoid. On the inner side of the trapezium is a lunate articulating facet which joins with the trapezoid.

Metacarpal I is much shortened and reduced. The proximal and distal articulating surfaces in the single available specimen which is not fused with the trapezium, closely resemble the corresponding faces in the first metacarpal of *Mylodon*. The former surface in *Nothrotherium* is narrow, elongated in dorso-ventral axis, and constricted at the middle with sigmoid curvature. The distal face presents a convexity with flattened base. In *Mylodon* a similar convexity at the end of the first metacarpal carries a digit of two segments, the distal one of which is an ungual phalanx. If the structure in *Nothrotherium* is directly comparable to that in *Mylodon*, the ungual phalanx must have been very small.

METACARPAL II.

If metacarpal II of *Nothrotherium* (fig. 23, A to E) is so oriented that the proximal extremity corresponds in position to that of *Hapalops*, the distal trochlea is directed inward much more obliquely (i. e., the lower end of trochlea is directed downward and inward) with reference to a vertical plane passing through the metacarpal than in the Miocene form. The trapezoid surface is somewhat more uniform than in *Hapalops*, lacking the deep median vertical groove. Towards the external side this surface is sigmoid in a dorso-ventral direction, while internally it is flatter. The dorso-external process of the proximal end is not quite so prominent as in the metacarpal of the Miocene form. In slenderness of the second metacarpal, and in the structure of its proximal extremity, *Nothrotherium* shows greater change from *Hapalops* than does *Megalonyx*. The character of rotated distal extremity of the metacarpal is possessed in greater degree by both Pleistocene genera than by the Miocene form.

TABLE 32.—*Measurements (in millimeters) of N. shastense.*

Fused trapezium and metacarpal I (No. 1912–R–1, 1913–R–1):	
Greatest length	52.7
Greatest depth of proximal end	27.6
Width of proximal end	20.3
Depth of distal end	20.6
Width of distal end	14.2
Metacarpal I (No. 1912–L–1):	
Greatest length	30.5
Depth of proximal end	20.8
Width of proximal end	18
Depth of distal end	19.2
Width of distal end	13.5

In *Nothrotherium* the facet on the outer side for metacarpal III is less extensive and the facet on the inner side is also much smaller than the corresponding facets in *Hapalops*. The latter facet is concave dorso-ventrally and articulates with the trapezium, which in *Nothrotherium* has fused with the first metacarpal. Both inner and outer facets are continuous with the trapezoid surface. The shaft, in contrast to that of metacarpal II of the Miocene genus and of *Megalonyx* is less quadrate and more nearly oval in section. At the distal end the carina is directed inward more than in *Hapalops*. A well-formed offset is present along the inner side, and along the lower half of the outer side a much narrower offset occurs.

The second metacarpal of *Nothrotherium* exhibits further differences from that of *Megalonyx* in the less triangular shape of the trapezoid surface and in the smaller extent of the outer facet for the median metacarpal.

TABLE 33.—*Measurements (in millimeters) of metacarpal II.*

	Nothrotherium shastense, No. 1914–L–1	N. shastense, No. 1914–L–2	Megalonyx jeffersonii, (after Leidy).	M. jeffersonii, (after Leidy).	M. jeffersonii, (after Leidy).
Greatest length	79.5	81.5	95.3	82.6	88.9
Depth of proximal end	29	26.4	44.5	44.5	44.5
Width of proximal end	24.6	25.5	....	....	....
Depth of distal end	45.8	43.2	50.8	50.8	44.5
Width of distal end	28.5	26.8	....	....	....
Least depth of shaft	23.4	....	....	....	....

PHALANX II, DIGIT II, MANUS.

The second phalanx of the index-finger (No. 1930–L–1, fig. 24*a*) is long and slender, exceeding in length the corresponding segment in digit III, manus, and the coossified first and second phalanges in digit III, pes. The proximal end is not very deep and supports two facets meeting in a thick median ridge. The shaft is distinctly constricted dorso-ventrally immediately behind the distal trochlea. The two condyles are separated by a median U-shaped groove.

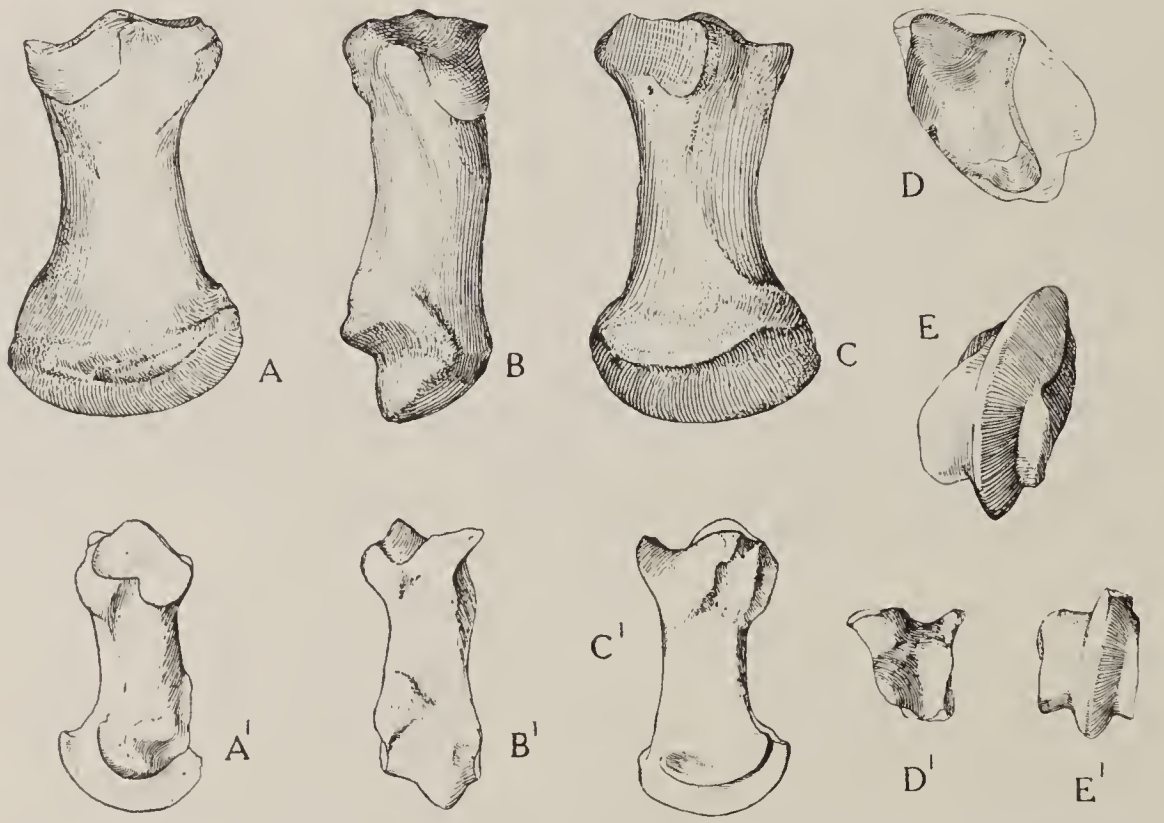

FIG. 23.—*Nothrotherium shastense* Sinclair. Left metacarpal II, No. 1914-L-1. *A*, inner view; *B*, dorsal view; *C*, outer view; *D*, proximal end; *E*, distal end. × 0.50. Rancho La Brea Pleistocene.
Hapalops sp. Left metacarpal II, No. 15171 P. U. C.; same views as in *A*, *B*, *C*, *D*, *E*. × 1.0. Santa Cruz Miocene.

The measurements (in millimeters) of phalanx II, digit II, manus of *N. shastense*, are: length through middle, 66.5; width of proximal end, 25; approximate depth of proximal end, 32; depth of distal end, 26.7.

PHALANX III, DIGIT II, MANUS.

Perhaps the most remarkable ungual phalanx of *Nothrotherium*, peculiar because of its decided difference from all other terminal phalanges, is that borne by the second digit of the hand. This specimen (No. 1931–L–1, fig. 25*a*) is identical with that shown by Reinhardt (1878, plate 4, figs. 8 and 9) and by Winge (1915, plate 24). In the manus of *Hapalops* the terminal phalanx of the second digit is no wider than other phalanges.

In *Prepotherium*, however, the corresponding ungual is broadened, but appears to have a somewhat different shape from that in *Nothrotherium*.

Contrasted with the ungual phalanx of digit II, pes, of *Nothrotherium*, the comparable phalanx in the manus is somewhat longer and of less depth. Its most peculiar characteristics are the wide and well-rounded claw-process and the great projection of this process beyond the hood. The latter projection is equal to that in the ungual phalanx of the median digit of the pes, although the latter segment is much larger. The ventral surface of the process just anterior to the base of the hood is not so broad as in the corresponding phalanx of the median digit, pes, but at the tip it is much broader.

There is no subungual process, the ventral surface of the hooded region being nearly flat. A distinct overhanging process at the proximal end is absent and the two articulating concavities are not directed downward as much as in other ungual phalanges of *Nothrotherium*. The median ridge is heavy.

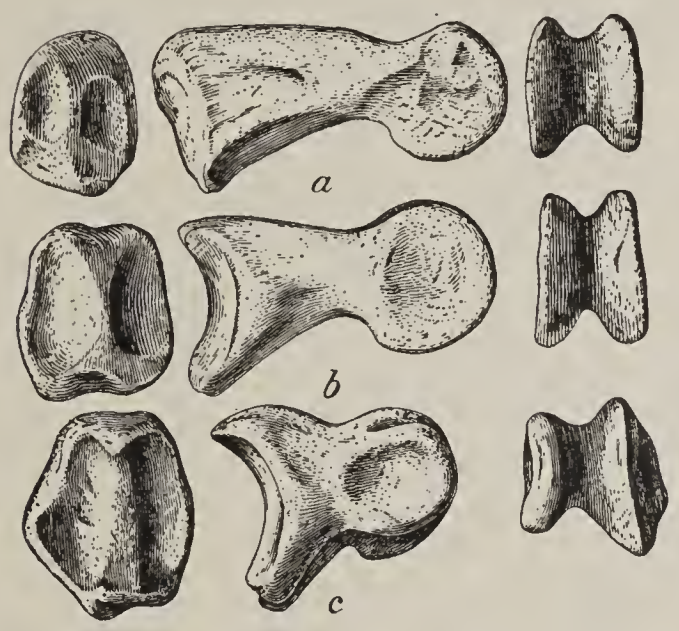

FIG. 24.—*Nothrotherium shastense* Sinclair. Second phalangeal elements of manus; proximal, lateral, and distal views. × 0.50. *a*, No. 1930-L-1, digit II; *b*, No. 1929-L-1, digit III; *c*, No. 1928-L-1, digit IV. Rancho La Brea Pleistocene.

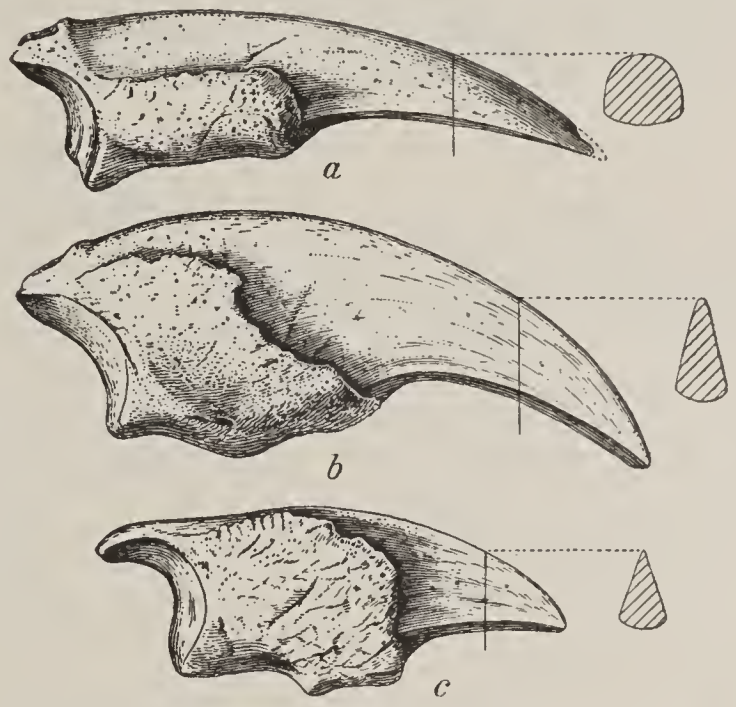

FIG. 25.—*Nothrotherium shastense* Sinclair. Ungual phalanges of manus, lateral views with cross-sections through claw-processes. × 0.50. *a*, digit II; *b*, digit III; *c*, digit IV. Rancho La Brea Pleistocene.

The measurements (in millimeters) of No. 1931–L–1, phalanx III, digit II, manus, of *N. shastense* are as follows: greatest length from posterior end of overhanging process to tip of claw-process (approximate) 115.6; depth of proximal end 33.2; width of proximal end 26.7; width of ventral surface of claw-process just anterior to hood 16.

PHALANX II, DIGIT III, MANUS.

This phalanx (No. 1929–L–1, fig. 24*b*) is slightly longer and heavier than the corresponding segment in the second digit, pes. It is shorter and stouter than phalanx II, digit II, manus. The proximal end is deeply excavated where the facets articulate with phalanx I. The median ridge is narrow at the middle, broadening above and more so below. Dorsal and ventral margins are straight, except where they are notched in median vertical axis. The distal trochlea is deep and relatively narrow as contrasted with the distal end of phalanx II, digit II, manus. The median furrow in No. 1929–L–1 is deep and narrow.

The measurements (in millimeters) of No. 1929–L–1, phalanx II, digit III, manus, of *N. shastense* are as follows: length through middle 56; width of proximal end 31; depth of proximal end 34; depth of distal end 29.3.

PHALANX III, DIGIT III, MANUS.

The ungual phalanx (No. 1890–L–1, fig. 25*b*) is larger than any of the terminal phalanges of the fore and hind feet, with the exception of phalanx III, digit III, pes. Contrasted with the latter, No. 1890–L–1 is considerably smaller. The phalanx is relatively narrow. At the proximal end the articulating surfaces are subequal. Within the hood the claw-process possesses a convex dorsal surface which is transformed anteriorly into a sharp edge extending to the tip. The end of the claw-process reaches well below the horizontal plane of the base, in which character No. 1890–L–1 differs from the terminal phalanges of other digits. A distinct tuberosity is situated at approximately the middle of the ventral surface of the subungual base. On each side posteriorly is a subungual foramen.

The measurements (in millimeters) of No. 1890–L–1, phalanx III, digit III, manus, of *N. shastense*, are as follows: greatest length from proximal end of overhanging process to tip of claw-process 127.5; greatest depth from dorsal surface of hood to ventral tuberosity (approximate) 53; width of proximal end 28; length of subungual base 54.5; width of ventral surface of claw-process just anterior to hooded region 12.5.

PHALANX I, DIGIT IV OR DIGIT III, MANUS.

A single specimen (No. 1932–L–1) appears to represent the proximal segment in the annular finger, but may belong to the median digit. It is deeper than the corresponding element (No. 1886–R–1) in the second digit, pes. A deep median furrow, which narrows below, traverses the length of the proximal end. Along the lower half of one side, presumably the inner side, an articulating offset occurs. Below this and on the ventral side is a facet, transversely elongated, for a sesamoid. A larger facet for a sesamoid is present on the opposite side. A greater extent of bone is present above the distal articulation in No. 1932–L–1 than in No. 1886–R–1. The distal articulation is not oblique with respect to a median plane passing through the proximal groove.

The following are the measurements (in millimeters) of phalanx I, digit IV or digit III, manus, of *N. shastense*, (No. 1932–L–1): depth 46.5; greatest length 26.9; greatest width 35.

PHALANX II, DIGIT IV, MANUS.

This segment (No. 1928–L–1, fig. 24*c*) is the shortest and stoutest of the second phalanges in the manus of *Nothrotherium*. The proximal end is greatly expanded dorsoventrally and the articulating facets are relatively large. At the distal end the two condyles diverge ventrally, the outer condyle extending farther downward and having a larger articulating surface than the inner condyle.

The following are the measurements (in millimeters) of phalanx II, digit IV, manus, of *N. shastense* (No. 1928–L–1): length through middle 37; width of proximal end 33; depth of proximal end 39.5; depth of outer condyle 30.2.

TABLE 34.—*Measurements (in millimeters) of phalanx III, digit IV, manus, of N. shastense.*

	No. 1933–R–1	No. 1933–R–2	No. 1933–L–1
Greatest length from posterior end of overhanging process to tip of claw-process.	101.6	100	[1]93
Greatest depth from dorsal surface of hood to discoid area on ventral surface.	43.8	44.8	41
Width of proximal end	31.4	29.6	27
Length of subungual base	....	....	47.6
Width of ventral surface of claw-process just anterior to hood	12	11	11

[1]Approximate.

PHALANX III, DIGIT IV, MANUS.

The terminal phalanx (No. 1933–L–1, fig. 25*c*) of the annular finger is the smallest of the series of functional ungual phalanges of the manus and pes. It approaches closest in size the terminal phalanx (No. 1888–R–1) of digit II, pes, differing chiefly from this segment in the character of proximal end and in the structure of the claw-process. The overhanging process is slender. The surface articulating with the outer condyle of phalanx II is narrow above and widens below. It reaches below the lower margin of the inner articulating facet. The latter facet is deeply concave. A median plane passed through the ridge between the two articulating facets is oblique to a median plane through the phalanx along the fore-and-aft axis.

The anterior end of the claw-process does not extend below the horizontal plane of the ventral surface of the subungual base as in No. 1888–R–1. The claw-process is relatively thick, and the sides of that portion projecting from the bony hood meet in a sharp edge. The inner of the two subungual foramina is the larger. The hood is well developed. The phalanx may show slight dorso-ventral constriction above the anterior border of the proximal articulation. For measurements see table 34.

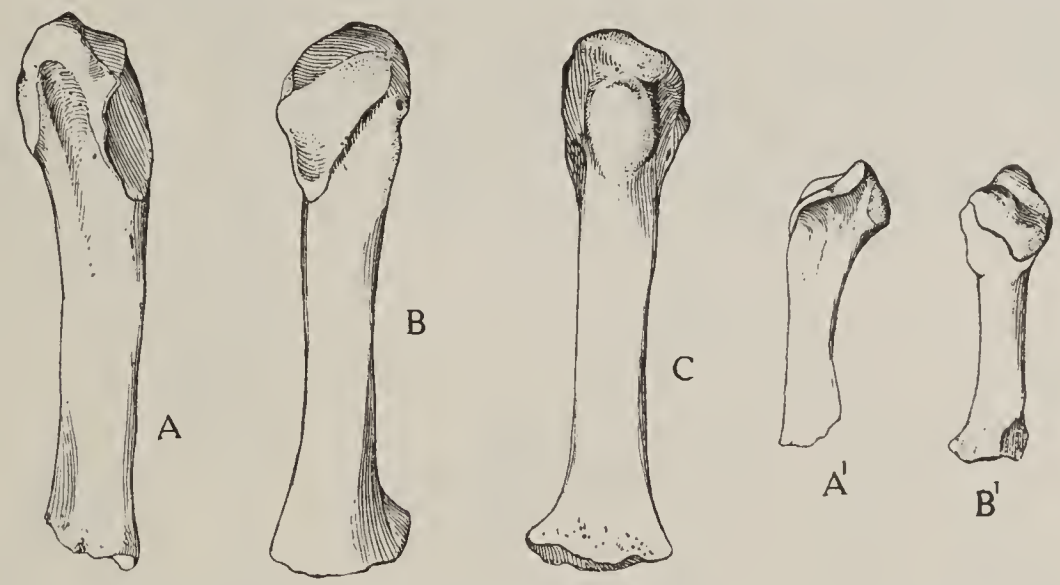

FIG. 26.—*Nothrotherium shastense* Sinclair. Right metacarpal V, No. 1917-R-1. *A*, dorsal view; *B*, inner view; *C*, outer view. × 0.50. Rancho La Brea Pleistocene. *Hapalops*, sp. Left metacarpal V, No. 15171 P. U. C. A^1, dorsal view, B^1, inner view. × 1.0. Santa Cruz Miocene.

METACARPAL V.

Only one specimen (No. 1917–R–1, fig. 26, A, B, C) of this metacarpal is available for study. The metapodial lacks the distal epiphysis. Metacarpal V is a slender element, much as in *Hapalops*. In *Megalonyx* the metapodial is somewhat heavier. The proximal extremity is distinctly less expanded transversely than in *Hapalops* and does not possess such an extensive articulating surface. The latter surface joins only with the unciform of the carpal elements, as shown in Winge's figure (Winge, 1915, plate 24) of the manus of *Nothrotherium maquinense*. In *Hapalops* also the fifth metacarpal, as seen in specimen 15171, Princeton University Collection, does not touch the unciform. In the fifth metacarpal of *Megalonyx*, however, a small facet is bent away from the unciform surface and articulates with the cuneiform. Along the inner side of the proximal end is the surface for metacarpal IV, which extends distally in its course from the ventral to the dorsal side. It is flattened below and becomes broader and concave above. Dorsally, the proximal extremity is grooved, while laterally it becomes a discoid flattened surface. The shaft is cylindroid, with flattened inner side. The distal end of metacarpal V in *Nothrotherium* is expanded in dorso-ventral extent as in that of *Megalonyx*, and the principal axis of this extremity is oblique to the dorso-ventral plane of the shaft. In *Hapalops* the metacarpal apparently carried a complete digit, but there is still doubt as to the nature of this digit in the Pleistocene megalonychids.

The measurements (in millimeters) of No. 1917–R–1, metacarpal V of *N. shastense*, are as follows: Length (approximate), 105.7; transverse diameter of proximal extremity, 24.1; dorso-ventral diameter of proximal extremity, 24.9; width of shaft at middle, 13.4; depth of shaft at middle 16.2.

COMPARISON OF MANUS.

Unfortunately, the manus of *Nothrotherium* from Rancho La Brea is not known by as complete material as the pes. Of the carpus, only the scaphoid and trapezium, the latter fused with metacarpal I, are available. The metacarpal series includes the first, second, fourth, and fifth, and the median three digits are fairly complete.

Judging from the Californian material and from the Brazilian collection described by Winge (1915), the manus (fig. 28) is like that of *Hapalops*, but is more specialized. Contrasted with the hand of *H. longiceps*, that of *Nothrotherium* exhibits a greater amount of interlocking of carpal elements. The scaphoid has broader contact with the magnum and the lunar apparently overlaps to some extent on the unciform. The trapezium is not fused with metacarpal I in *Hapalops*, while in *Nothrotherium*, as in *Megalonyx*, such fusion occurs.

27

28

FIG. 27.—*Megalonyx*, probably *wheatleyi* Cope. Right manus, Amer. Mus. Spec., dorsal view. × 0.50. Port Kennedy fissure, Pennsylvania, Pleistocene.

FIG. 28.—*Nothrotherium maquinense* (Lund). Right manus, dorsal view, after Winge. Approx. × 0.66. Brazil, Pleistocene.

The four outer metacarpals are comparable in their relative lengths to those of *Hapalops* and of *Megalonyx*. The metapodials are more slender than those of *Megalonyx* (compare figures 27 and 28). This is particularly evident in the fifth metacarpal. Metacarpal I is not so reduced in length as it is in *Megalonyx*. Metacarpal II differs in shape more from that in *Hapalops* than does that of *Megalonyx*.

The first metacarpal may have carried a small functional digit, but as yet no remains of it have been identified. The second, third, and fourth digits have each the full complement of phalanges. In digit II the second phalanx is relatively very long and slender and the terminal phalanx bears a claw-process which is much wider than in

Hapalops. The ungual phalanx of digit III is the largest of the series in the manus, but is decidedly smaller than that in the third digit of the pes. In this respect *Nothrotherium* resembles *Megalonyx*. In *Hapalops*, phalanx III, digit III, manus, is also smaller than that in the pes, but the difference is not so marked as in the Pleistocene genera. The ungual phalanx of digit IV shows less freedom of movement than in digits III and II. No remains of digit V have been found. The digit may have been more reduced than in *Hapalops*.

PELVIS.

A nearly complete pelvis (plates 10, 11) is available from Rancho La Brea, and a second specimen not so well preserved as the first and belonging to a young animal is also present. Besides this material, there are in the collections from the asphalt deposits a few fragments which fortunately indicate some of the parts missing in the former specimens. The pelvis of *Nothrotherium* exhibits many interesting resemblances to that of the Miocene genus *Hapalops*, with some notable changes in structure from those found in the latter form.

Nothrotherium is less like the Tardigrada than is *Hapalops* and resembles more the large Pleistocene Gravigrada in the lateral expansion of the pelvis. The wing-like development of the ilia in the Pleistocene megalonychid from Rancho La Brea is due, as already pointed out by Scott (1903, p. 170) for *Megatherium* and *Mylodon*, to the increase in size of the animal with accompanying enlargement of the viscera to be supported. In lacking an excessive expansion of the ilium and a great forward projection of the superior border as in *Mylodon*, the pelvis of *Nothrotherium* reflects the size of the animal, for although the genus is decidedly larger and bulkier than the Miocene form, it is smaller and considerably more slender than *Mylodon*.

The anterior or inner surface of the ilium is deeply concave in the area adjacent to the sacrum and has a shallow depression near the outer border. Between these two areas the middle upper portion of the inner surface is convex. A number of low ridges on the inner surface of the ilium tend to converge from the anterior superior border towards the acetabular border. The labium of the ilium is not such a prominent feature as in the pelvis of *Mylodon*. It is bent forward, and for the greater part of its course is narrow, excepting towards the sacrum, where it increases considerably in width. The gluteal surface faces posteriorly and somewhat upward. This surface is concave over its middle portion and is also traversed by numerous ridges for muscle attachment.

Nothrotherium has no oblique ridge connecting the labium with confluent articular processes of the anterior sacrals, as in *Mylodon robustus*. In the former genus the articular processes of each of the five sacrals are distinct. The labium does, however, connect posteriorly with the fused ends of the transverse processes. As seen from above, the four foramina located between the transverse processes and giving exit to the divisions of the sacral nerves are subcircular or oval in shape and increase but slightly in size posteriorly. The second and third ventral openings for divisions of the sacral nerves are situated about opposite the middle of the sacro-ischiadic foramen, while the first is situated in advance of the forward border of the latter opening. Broad canals lead from these ventral openings to the sacro-ischiadic foramen. The acetabular border is ventral rather than external. The acetabulum is large, and although the sulcus for the round ligament is prominent, the articulating surface in the socket is still quite extensive. The sulcus incises the articulating surface from the lower posterior or obturator border of the acetabulum.

In specimen 1892–1 the sacro-ischiadic foramen is of relatively small size. As in *Hapalops longiceps*, the tuberosity of the ischium in *Nothrotherium* is large and prominent, more so than in the pelvis of *Mylodon*. The descending bar of the ischium, extending ventral to the tuberosity and forming the posterior side of the obturator foramen,

is flattened laterally and is comparatively thin. The bar forming the anterior side of the foramen is rounded. Below the obturator foramina the sides inclosing the pelvic opening meet in the pubic symphysis at an angle of approximately 80 degrees. The obturator foramen is quite large, with its shortest border along the ischium between acetabulum and ischial tuberosity, and the longest border along the pubic bar. As in *Mylodon*, the upper border of the foramen, situated on the inner side of the acetabular portion of the pubis, is notched by the canal for the obturator nerves and blood-vessels. In posterior view, plate 10, figure 1, the pelvic opening in *Nothrotherium* is seen to be large and narrows more sharply to the ventral side than in the pelvis of *Mylodon*.

TABLE 35.—*Measurements (in millimeters) of pelvis of N. shastense.*

	1892–1	1892–2	1892–3
Greatest transverse width across ilia	[1]846	.....	.....
Length from anterior border of ilium to tuberosity of ischium	456	.....	.....
Width of ilial wing, measured parallel to posterior border	318	.....	.....
Antero-posterior diameter of ilial wing through middle	272	.....	.....
Length of posterior descending process of ischium, measured from superior border to ventral symphysis	285	.....	.....
Dorso-ventral diameter of pelvic opening, measured from posterior end of ischial symphysis to ventral border of last sacral vertebra	222	.....	.....
Greatest transverse diameter of pelvic opening, measured between inner surfaces of ischia	249	238	.....
Greatest width of posterior end of pelvis, measured across posterior ends of ischia	346	[1]346	.....
Antero-posterior diameter of left acetabulum	89.8	102.5	.....
Length of fused sacral vertebrae, measured from middle of anterior face of first sacral to middle of posterior face of last sacral	231	254	.....
Transverse distance between outermost border of sacro-ischiadic foramen of each side, measured across ventral surface of sacrum	227	263	.....
Transverse diameter of centrum of first sacral, measured across anterior face	84.6	91.8	.....
Depth of centrum of first sacral	46.4	44	.....
Transverse diameter of neural canal of first sacral, internal measurement	57.6	62.4	.....
Height of neural canal of first sacral, internal measurement	39	43.4	.....
Depth of centrum of last sacral	40	40.2	.....
Transverse diameter of last sacral, measured across posterior face of centrum	82	87	.....
Greatest transverse width of sacrum, measured above sacro-ischiadic foramina	[1]238	238	.....
Length of crest formed by fused dorsal spines	224	257.6	.....
Greatest width of dorsal crest at anterior end	36	.....	.....
Height of dorsal crest at anterior end, measured from base of centrum	157	.....	.....
Height of dorsal crest at posterior end, measured from base of centrum	102	105.7	.....
First sacral, width across anterior end of neural arch, i. e., across supports for prezygapophyses	.....	93.6	.....
Last sacral, greatest width across postzygapophyses	52	61	.....
Longest diameter (dorso-ventral) of obturator foramen	.....	.....	130.7
Greatest diameter taken normal to dorso-ventral diameter	.....	.....	79.6

[1] Approximate.

FEMUR.

A single complete femur (No. 1871–L–1, plates 12 and 13) from Rancho La Brea is much larger than the specimen described by Reinhardt and belongs to an older individual. Contrasted with that of *Megalonyx*, the femur of *Nothrotherium* is much smaller; the third trochanter is situated relatively lower on the outer side, the latter border being concave for a greater distance above it; the shaft is relatively narrower transversely above the third trochanter, and the lesser trochanter is not so well developed.

The head is comparatively not so prominent, and the great trochanter does not reach proximally so far as in the femur of *Hapalops*. Between them the superior surface of the femur from Rancho La Brea is nearly flat and not concave, as in that of *Hapalops*. The digital fossa is small. The pit for the ligamentum teres (plate 12, fig. 1A) is small, semi-oval in shape, and entirely inclosed by the articular surface of the head, as in *Hapalops*. The second or lesser trochanter is much less conspicuous in than the Miocene

genus, having more the appearance seen in *Megalonyx*. It is less developed in *Nothrotherium shastense* than in the Brazilian species. The femur of *Nothrotherium*, as that of *Megalonyx*, possesses a third trochanter, which is less conspicuous than in *Hapalops*. It is situated relatively lower on the shaft in *Nothrotherium* than in *Hapalops*. In the

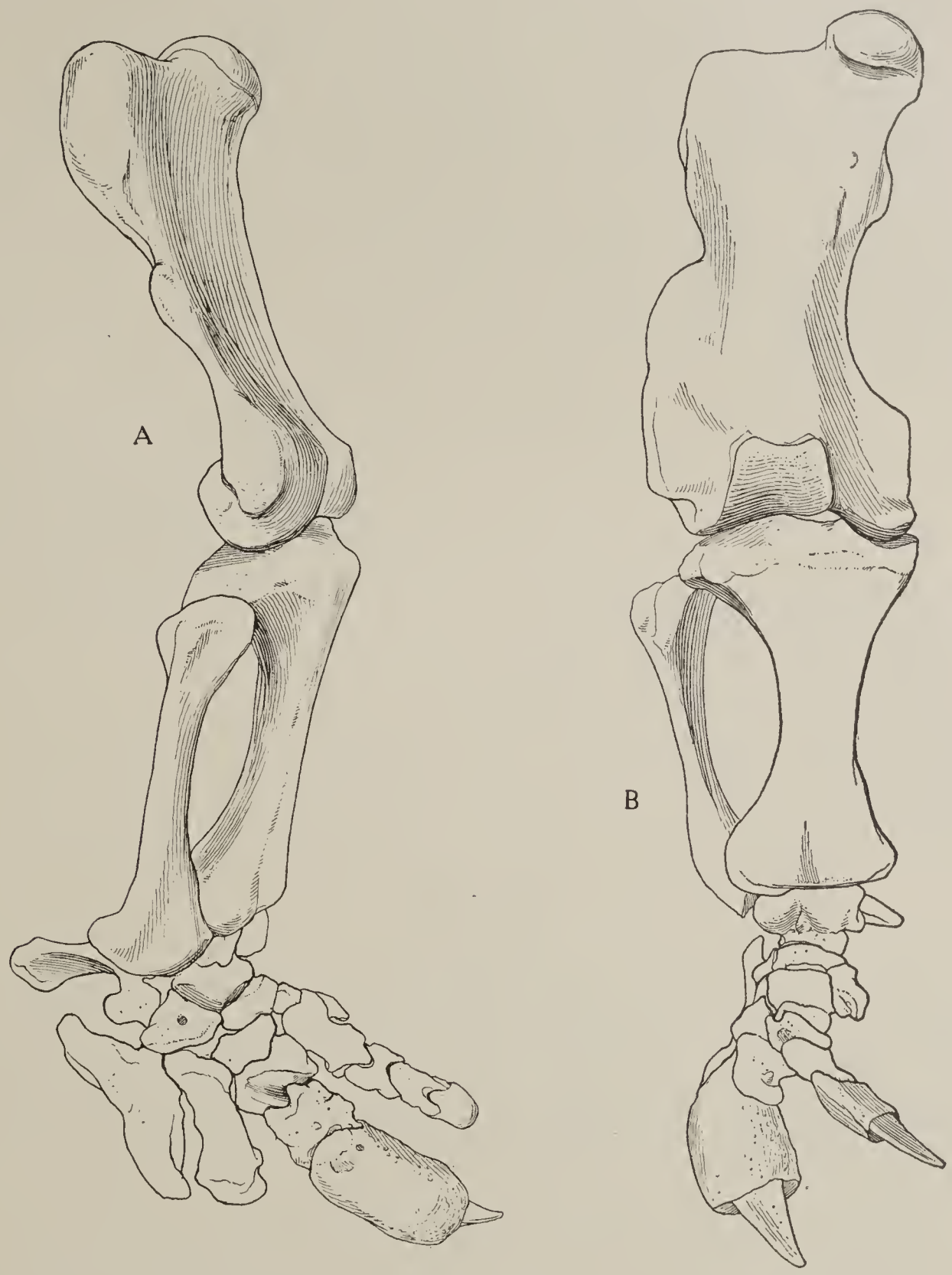

FIG. 29.—*Nothrotherium shastense* Sinclair. Right posterior limb. *A*, lateral view; *B*, anterior view. × 0.166. Rancho La Brea Pleistocene.

Rancho La Brea specimen the outer border of the third trochanter is more directly continuous with that of the external tuberosity than in *Hapalops*. This causes the distal half of the femur of the Pleistocene form to become relatively wider, and resembles more that in *Prepotherium*.

The shaft is of least width immediately above the third trochanter and at approximately the middle. It is thickened in a line extending obliquely across from the great

trochanter to the internal condyle. The lower half of the thigh-bone lies in a plane which turns inward and is oblique to a vertical plane passing through the head and great trochanter. This obliquity is not a noticeable feature in the femur of *Hapalops* under observation.

At the distal end (plate 12, fig. 1*b*) the two articulating surfaces of the condyles and that for the patella are separate, in which respect the femur of *Nothrotherium* resembles that of *Hapalops* and of *Megalonyx* and differs from that of *Mylodon*. The condyles are entirely hidden in anterior view. The inner condyle has the larger articulating area and is convex, while the outer one is flattened or slightly concave transversely. The concave rotular surface is deeper in dorso-ventral extent, but not so wide transversely as in *Megalonyx*. It is more closely approached by the articulating face of the inner condyle in the femur of *M. jeffersonii* than in that of *Nothrotherium*. The rotular surface overlaps the external condyle, although separate from it, decidedly more than in the femur of the Brazilian species, and is like *Megalonyx* in this respect. No distinct supra-patella fossa is present. Continuous with the articulating surface of the external condyle, but on the proximo-posterior border, is a small facet for a fabella.

TABLE 36.—*Measurements (in millimeters) of femur.*

	Nothrotherium shastense, No. 1871–L–1	Morotherium gigas, No. 11898 Yale Univ. Coll.	Megalonyx jeffersonii, (after Leidy).
Greatest length, measured from head	397.7	.....	546.1
Greatest length, measured from great trochanter	386	415	.....
Width, measured obliquely from head to great trochanter	186	223	254
Thickness of shaft at middle	49.3	51	.....
Least width of shaft	112	127.7	.....
Greatest width across distal tuberosities (above condyles)	196.3	.....	254
Width across condyles	168	.....	215.9
Width of rotular groove	70	81.4	101.6
Least width of intercondyloid space	35	[1]40	.....
Width of inner condyle	74.7	.....	.....
Vertical extent of inner condyle	84.9	.....	.....
Width of outer condyle	58.3	76	.....

[1] Approximate.

PATELLA.

The patella of *Nothrotherium* (plate 12, figs. 2 and 3) is very close in general shape and proportions to that of the Brazilian species figured by Reinhardt (1878, plate 4, fig. 5). The femoral surface is relatively large, convex transversely and concave dorso-ventrally, thus differing from *Megalonyx*, in which it is nearly flat in the latter direction. The articulating surface is approximately of even dorso-ventral diameter throughout, and below this the ventral half of the patella is perhaps a little more tongue-shaped than in the Brazilian form.

The patella is somewhat shorter in dorso-ventral extent than the specimens of the knee-cap belonging to *Megalonyx* and available from the asphalt deposits, but is relatively much narrower. In latter character, as well as in shape of femoral surface, *Nothrotherium* differs decidedly from *Hapalops*. The patella of the Miocene genus is closer in shape to that of *Megalonyx*. The dorsal surface of the patella in *Nothrotherium* is relatively much thicker than in that of *Megalonyx*. The anterior face is marked by a number of longitudinal ridges. The measurements in millimeters of the patella of *N. shastense* No. 1895–L–1, are as follows: Dorso-ventral diameter, 92.8; width, 61.3; dorso-ventral diameter of femoral surface, 48.5; transverse diameter of femoral surface, 59.8; thickness through femoral surface, 35.2.

TIBIA.

The tibia (plate 14, figs. 1, 1*a*, 1*b*, 2) of *Nothrotherium*, contrasted with that of *Megalonyx*, is smaller but quite similar in general shape. In the Rancho La Brea specimens the superior border of the anterior face, viewed from above, extends practically in a straight transverse direction. This is due to an extension of the anterior tuberosity for attachment of the ligamentum patellae to the outer side. The expanse of bone anterior to the outer femoral articulating surface is much greater than that in front of the inner articulation, and reaches nearly to the outer margin of the surface. In *Megalonyx* the greatest development of the tuberosity occurs in front of the gutter separating outer and inner femoral surfaces.

TABLE 37.—*Measurements (in millimeters) of tibia.*

	Nothrotherium shastense, No. 1870–R–1	N. shastense, No. 1870–L–1	Megalonyx jeffersonii, (after Leidy).
Greatest length, measured along middle of shaft	[1]317	308	.....
Greatest length, from middle of posterior border of inner femoral surfaee to most distal point on tendinal groove	313	[1]292	381 (?)
Greatest transverse width of proximal end	190.8	178	215.9
Least width of shaft	67	56.4	[1]76.2 (?)
Greatest transverse width of distal end	142.8	129.3	165.1
Thickness of proximal end, from anterior border to most backward projeeting part of outer femoral surface	121.6	103.8	.....
Greatest transverse diameter of inner femoral surface	85.6	80.5	.....
Thiekness at middle of proximal end	86.4	72.5	139.7
Thiekness of shaft at middle	50.6	46	.....
Thiekness of distal end	73.2	63	88.9

[1] Approximate.

The attachment of the patella ligament in *Nothrotherium* is, then, relatively farther toward the outer side of the tibia than in *Megalonyx*. This appears to accompany the position of the distal condyles of the femur situated in a transverse plane, which is oblique to a plane passing transversely through the upper portion of the shaft of the femur. The obliquity of the distal end of the femur with reference to the proximal end causes the tibia to face inward as well as anteriorly and brings the fibula well around to the lateral side of the lower leg. With the plane of the front face of the tibia directed anteriorly, the fibula would occupy a position well posterior to the outer side of the tibia.

The anterior face of the tibia along the superior border is greatly roughened, and the antero-internal border of the shaft is also very rugose. The shaft is thickest along the inner side and narrows laterally. It is relatively narrower transversely than in the tibia of *Hapalops* and is more compressed antero-posteriorly toward the outer side. The inner femoral articulating surface is large, subcircular, and concave. The antero-external portion of this face is steeply inclined to form the inner side of the dorsal spine. The latter is relatively more prominent than in the tibia of *Hapalops*. The outer femoral surface is for the most part nearly flat and extends well posterior to the inner femoral surface (plate 14, fig. 1*a*). The fibular facet at the proximal end is more elongate transversely than in the tibia of *Megalonyx*. It is confluent with the outer femoral surface toward the inner posterior side, but forms a distinct angle with this surface.

The inner malleolus is relatively much broader transversely in *Nothrotherium* than in *Megalonyx* and extends farther along the postero-inferior border of the tibia. It is as prominent as in the tibia of *Hapalops*. It supports posteriorly two tendinal grooves as in the Miocene genus, the external of which is quite broad, while the internal groove is much narrower. The latter channel swings well around to the antero-internal side at its lower end. In *Mylodon* only a single broad groove is present in this region of the

tibia. The articulating surfaces for astragalus and fibula extend obliquely across the distal end from in front backward and inward. The inner and outer surfaces for the astragalus are separated by an obscure ridge. The fibular facet is wide in front and narrows behind. The distal spine for the astragalus is well developed, as in *Hapalops*.

The ratio of tibial length to femoral length has been computed from specimens not pertaining to the same individual. In *Nothrotherium* the ratio is: length of tibia to length of femur as 0.796 to 1. Presumably the ratio is greater than this and is more like that found in *Megalonyx*. In *Hapalops longiceps* the ratio is: length of tibia to length of femur as 0.768 to 1. W. K. Gregory records the ratio 0.72 to 1 for *Hapalops* sp.

FIBULA.

The fibula (plate 14, fig. 3) is long and slender, with comparatively widely expanded proximal and distal extremities. Compared with the fibula of *Mylodon*, that of *Nothrotherium* is very much more slender in the region of the shaft and is longer. While the proximal extremity is greatest in fore-and-aft diameter, the distal extremity is of greatest diameter transversely. The proximal articulation with the tibia is usually an elongate and narrow surface, but may be short and rather broad. The small facet for the fabella, having a postero-dorsal position on the proximal extremity of the fibula, is not invariably present on fibulae from Rancho La Brea.

TABLE 38.—*Measurements (in millimeters) of fibula of N. shastense.*

	No. 1869–L–2	No. 1869–R–1
Length through shaft	299	[1]324
Greatest antero-posterior diameter of proximal end	69.6	81.5
Transverse diameter of proximal end	59.9	61
Antero-posterior diameter at middle of shaft	30	....
Transverse diameter at middle of shaft	23	....
Antero-posterior diameter of distal end	58.3	62.8
Greatest transverse diameter of distal end	85.3	87.9

[1] Approximate.

The tibial or inner side of the shaft is flattened, while the remaining surface is convex. The distal end is roughly pyramidal in shape, with the transverse diameter greater than the antero-posterior diameter. Below the tibial facet the external malleolus is massive and bears along the inner side a concave triangular, articulating surface for the astragalus. The base of this facet is confluent with, but distinguished by a sharp angle from, the tibial facet. The astragalar surface is directed downward as well as inward, while the tibial facet faces upward and inward.

The fibula of *Nothrotherium* resembles greatly that of *Hapalops*. In proportion to its length and to size of shaft the fibula of the Pleistocene genus has heavier extremities than that of *H. longiceps*.

CALCANEUM.

A single calcaneum of *Nothrotherium* (No. 1877–R–1, fig. 30, A, B, C) is available from Rancho La Brea and lacks only the posterior border of the tuber calcis. In length and slenderness of neck the calcaneum of *Nothrotherium* differs decidedly from that of *Megalonyx* (compare with fig. 47, p. 106). It differs also from *Hapalops*, in which form the neck of the calcaneum is relatively broader than in that of *Megalonyx*. The posterior end is not so expanded in *Nothrotherium* as in *Hapalops*. The dorsal side of the fan-like expansion is concave, while the ventral side is broadly convex. The fibular border of the neck is thick, the neck narrowing toward the inner side.

At the articulating end of the calcaneum the external astragalar facet is relatively small, more prominently placed, and does not extend upon the neck so far as in *Hapalops*. At its upper inner border a semi-cone-shaped protrusion of the facet articulates with the concavity or channel described on the external calcaneal facet of the astragalus. With the above exception the facet is nearly flat transversely and slightly convex dorso-ventrally.

FIG. 30.—*Nothrotherium shastense* Sinclair. Right calcaneum, No. 1877-R-1. *A*, inner view; *B*, view of articulating end; *C*, dorsal view. × 0.50. Rancho La Brea Pleistocene.
Hapalops elongatus Ameghino. Right calcaneum, No. 15155, P. U. C., A^1, B^1, C^1, same views in *A*, *B*, *C*; × 1.0. Santa Cruz Miocene.

The external astragalar facet is separated from the smaller internal facet and from the cuboid surface by a channel which is deeper than in the calcaneum of the Miocene genus and is continued farther up on the dorsal face as a shallow groove. The internal astragalar facet of the calcaneum is nearly circular and is relatively smaller than in *Hapalops*. It is situated less in front of and more to the inner side of the large astragalar facet than in the latter. It is joined with the cuboid facet below by a narrow bridge of

bone, thus differing from *Megalonyx*. The cuboid facet is somewhat larger than the smaller of the two astragalar facets and is concave in its long diameter. The postero-inferior side of this facet is produced outward into a more conspicuous, but relatively more slender, plate-like process than in *Hapalops*. The latter process is absent in the calcaneum of *Megalonyx*.

The calcaneum of *H. longiceps* differs from that of *Nothrotherium*, according to Scott, in that "the external astragalar facet is smaller, more simply convex, and less reflected upon the dorsal side; the sustentaculum is smaller and its facet is smaller and more distal, less dorsal; the cuboid surface is more oval." In the calcaneum of *Hapalops* before me the external astragalar facet is relatively larger and more reflected upon the dorsal surface than in No. 1877–R–1 from Rancho La Brea. The sustentaculum is not so prominent as in the latter, but the facet which it bears is relatively larger than that in the calcaneum from the asphalt beds.

Contrasted with the fragment of a calcaneum (No. 19871, U. C. C.) of *Nothrotherium* from the Pleistocene of Hawver Cave (Stock, 1918, p. 510, fig. 29), the Rancho La Brea specimen exhibits some points of difference. In No. 1877–R–1 the cuboid facet is distinctly larger than the sustentacular facet, while in the cave specimen the cuboid facet and the sustentacular facet are of nearly equal size, with the latter perhaps slightly larger. The interspace between the two facets is also greater in the calcaneum from the asphalt. The internal channel between cuboid facet and large external facet for the astragalus is relatively wider in No. 1877–R–1. The lower end of the large astragalar facet is narrower in the Rancho La Brea specimen.

TABLE 39.—*Measurements (in millimeters) of calcaneum of N. shastense, No. 1877–R–1.*

Least transverse width of neck	39
Thickness of neck	24.5
Distance from inner border of sustentaculum to infero-external prominence of articulating end	77.7
Distance from dorsal border of external astragalar facet to ventral border of cuboid facet	70.5

ASTRAGALUS.

In *Nothrotherium* the astragalus (fig. 31, A to D) is relatively shorter, wider, and deeper than in *Hapalops*, with the tibial surface higher and more convex. The convexity of this surface with the inner extension of an odontoid shape modifies the astragalus considerably from that of *Hapalops*. These characters are much more marked than in the astragalus of *Megalonyx*, the latter genus retaining rather the type of structure found in Miocene forms (compare in fig. 31, A^1 to D^1 with A^2 to D^2). The astragalus of *Nothrotherium* resembles more in general appearance that of *Mylodon*. The outer portion of the tibial surface is not so sharply separated from the fibular surface as in *Hapalops*. At the middle of the distal border of the tibial articulation is a V-shaped notch as in *Hapalops*, ending in a depression that receives a process of the tibia. This notch may be quite large.

The external calcaneal facet resembles that in the astragalus of *Hapalops* and differs from that in *Megalonyx* in its greater concavity. It differs from that in *Hapalops* in the development of a broad and deep channel on the internal side of the posterior half, which meets the interarticular gutter opposite the facet for the sustentaculum. The facet for the sustentaculum forms the posterior surface of the head and is less distinct than in the Miocene form.

The neck is much better defined than in the astragalus of *Hapalops*. As in the Miocene genus, the cuboid facet is on the palmar side of the head, at least in major part. The head is less elongate and more rounded than in the astragalus of *Hapalops*. The depression on its anterior surface for the mammillate surface of the navicular may vary in depth. This surface is reflected to the inner side, corresponding with the concavity of the navicular. The outer dorsal margin of the depressed area is quite prominent in some

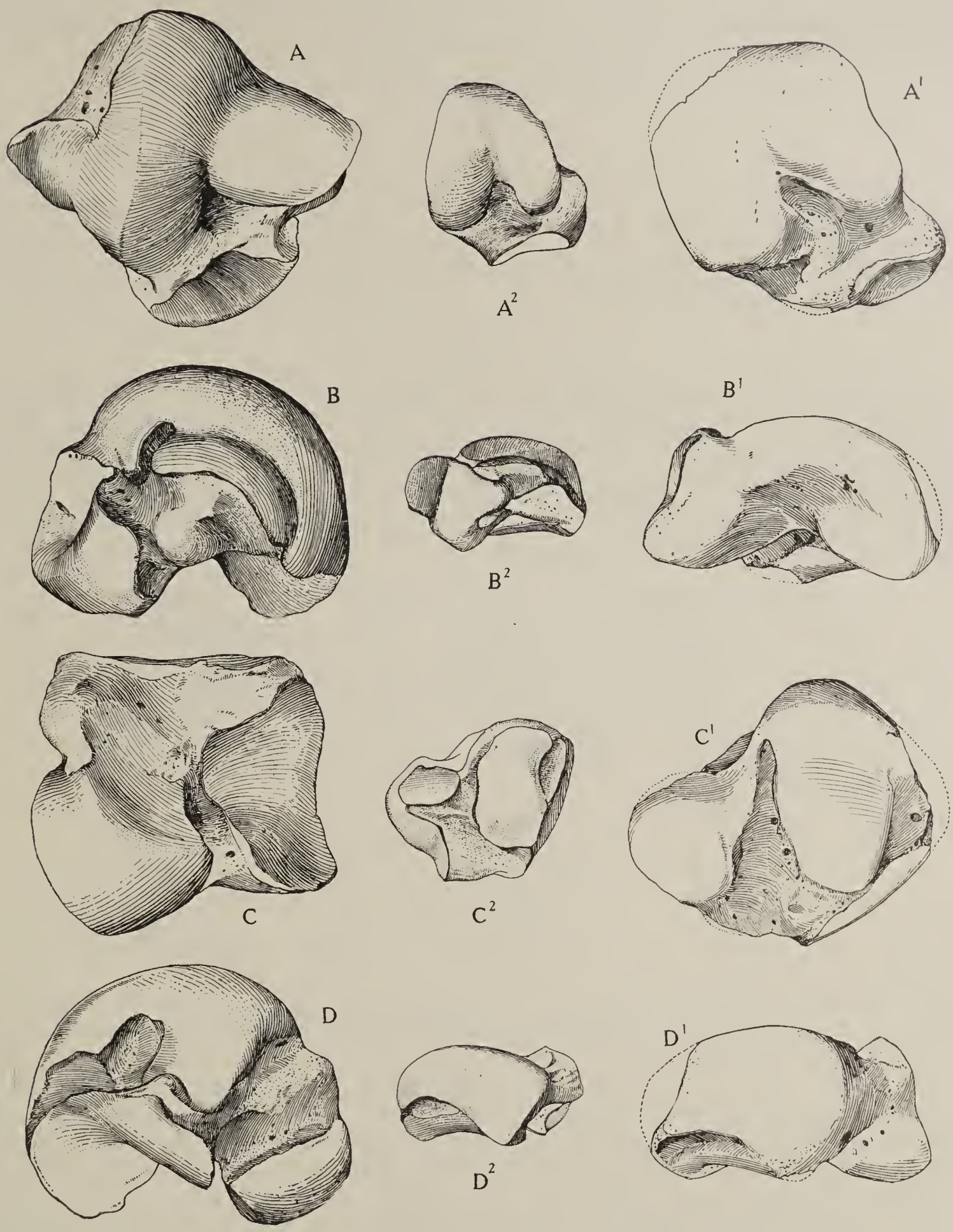

FIG. 31.—*Nothrotherium shastense* Sinclair. Right astragalus, No. 1875-R-1. *A*, tibial view; *B*, inner view; *C*, calcaneal view; *D*, lateral view. × 0.50. Rancho La Brea Pleistocene.

Megalonyx, probably *wheatleyi* Cope. Right astragalus, Amer. Mus. Spec. A^1, B^1, C^1, D^1, same views as in *A*, *B*, *C*, *D*. × 0.50. Port Kennedy fissure, Pennsylvania, Pleistocene.

Hapalops sp. Right astragalus, No. 15594, P. U. C. A^2, B^2, C^2, D^2, same views as in *A*, *B*, *C*, *D*. × 1.0. Santa Cruz Miocene.

specimens from Rancho La Brea. The dorsal border of the depressed navicular surface may be separated from the anterior border of the tibial articulation by a rather broad channel, thus defining the neck region, or may closely approach that border.

TABLE 40.—*Measurements (in millimeters) of astragalus of N. shastense.*

	No. 1875–L–2	No. 1875–R–2	No. 1875–R–3	No. 1875–R–4	No. 1875–R–5
Greatest antero-posterior diameter	102.4	100.7	105.2	91.3	102
Greatest transverse diameter, measured at a right angle to antero-posterior diameter	97.8	104	106.3	102.6	108.2
Depth of fibular side at distal end	64.5	62.7	69.6	61.2	67.5
Greatest diameter of head across navicular depression	50	53.6	56	49.4	53.8
Greatest antero-posterior thickness of head	42.7	44.6	50	42	44.4

CUBOID.

In *Nothrotherium* the pyramidal shape of the cuboid (fig. 32, A, B, C) is more markedly defined than in *Hapalops*. This is brought about by a closer approximation of the astragalar facet distally to the plane of the metatarsal surface. *Nothrotherium* differs also from *Megalonyx* in this respect. The calcaneal facet is convex and prominent as in *Hapalops*, oval in shape, and extends across almost the entire length of the fibular side of the cuboid. The astragalar facet is large and decidedly more concave than in the Miocene genus. It meets the calcaneal facet in a sharp angle.

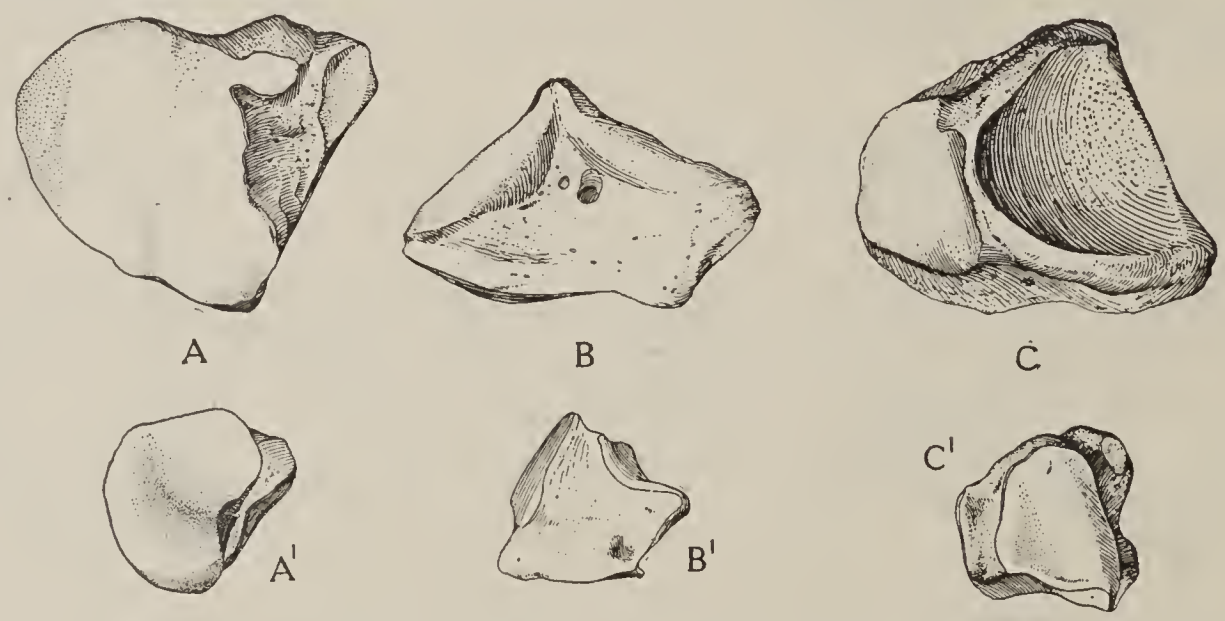

FIG. 32.—*Nothrotherium shastense* Sinclair. Right cuboid, No. 1885-R-1. *A*, distal view; *B*, dorsal view; *C*, proximal view. × 0.50. Rancho La Brea Pleistocene.
Hapalops indifferens Ameghino. Right cuboid, No. 15110, P. U. C. A^1, B^1, C^1, same views as in *A*, *B*, *C*. × 1.0. Santa Cruz Miocene.

As in *Hapalops* and *Megalonyx*, the inner border of the cuboid in *Nothrotherium* is formed by a narrow articulating face for the navicular. This surface is continuous with, but sharply separated from, the astragalar facet. The navicular surface may be evenly continuous with an ectocuneiform facet along its dorsal half, as in No. 1885–L–1, or it may be separated from this facet by a distinct angle. In three specimens of the cuboid of *Megalonyx* from the Pleistocene of the Port Kennedy fissure and in the collections of the American Museum of Natural History no connection was noted between these two surfaces. In the cuboid of *Nothrotherium* the articulating surfaces for metatarsals IV and V are continuous and not sharply separated from each other. This combined surface is distinctly more external to the ectocuneiform facet in Nos. 1885–R–2 and 1885–L–1 from Rancho La Brea than in the cuboid of *Hapalops*. It has a shape somewhat

like that in *Megalonyx*, but the inner border is not so evenly concave, as shown by Leidy for that genus. The articulating surface for the metatarsals in *Nothrotherium*, as in *Megalonyx*, is wider than deep, while in *Hapalops* the depth is greater than the width.

TABLE 41.—*Measurements (in millimeters) of cuboid of N. shastense.*

	No. 1885-L-1	No. 1885-R-2	No. 1885-R-1
Greatest distance between facets for astragalus and metatarsal V, measured across calcaneal facet	43.6	42.8	44
Greatest depth, measured over navicular facet	44.1	43.2	60.2
Greatest width of distal face, measured from middle of plane of navicular facet to external end	58.3	59.2	60.3

NAVICULAR.

The navicular of *Nothrotherium* (fig. 33, A, B, C) differs decidedly from that of *Megalonyx* in its oval shape. In the latter genus, as is well shown by Leidy (1855, plate 13, figs. 7 and 8) for *M. jeffersonii* and by W. J. Sinclair (1905, plate 20, figs. 5 and 6) for *M. sierrensis*, the navicular is roughly triangular in form, the base of the triangle bordering the concavity and apex situated above the convexity for the astragalus. The form of the navicular in *Hapalops* is more like that in *Megalonyx* than like that in *Noth-*

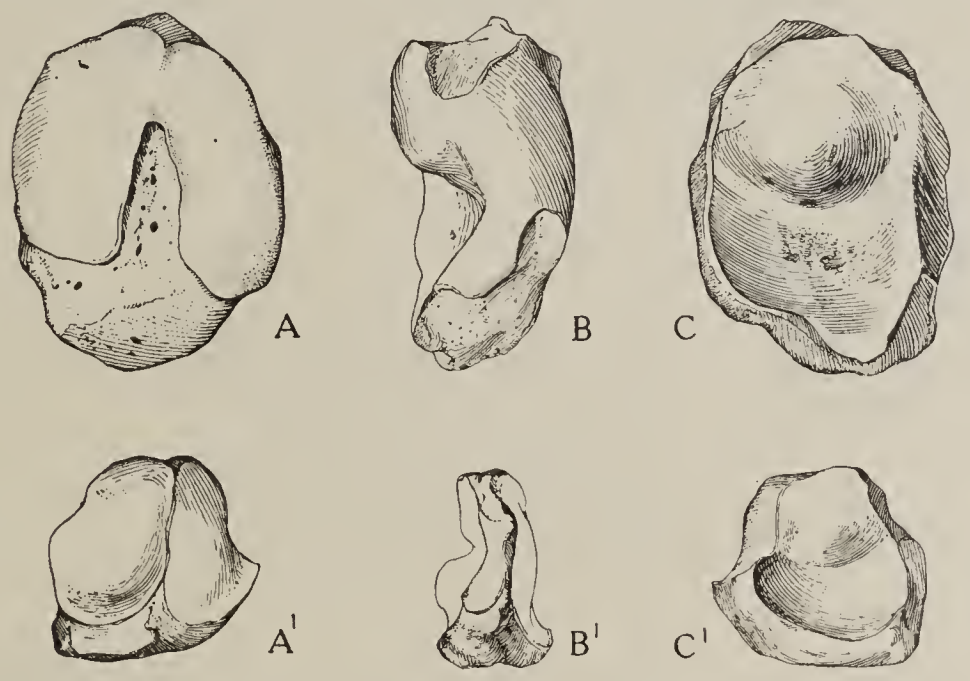

FIG. 33.—*Nothrotherium shastense* Sinclair. Right navicular, No. 1891-R-1. *A*, distal view; *B*, view of cuboid face; *C*, view of astragalar face. × 0.50. Rancho La Brea Pleistocene.

Hapalops elongatus Ameghino. Right navicular, No. 15545, P. U. C. A^1, B^1, C^1, same views as in *A*, *B*, *C*. × 1.0. Santa Cruz Miocene.

rotherium. A navicular belonging presumably to a megalonychid ground-sloth and described by Sinclair[a] from the Snake Creek Lower Pliocene of Nebraska approximates more closely the corresponding element in *Megalonyx* and in *Hapalops* than it does that of *Nothrotherium* from Rancho La Brea.

The mammiform surface of the proximal side (fig. 33, C), which articulates with the concave surface on the head of the astragalus, may vary in degree of convexity, as it does also in the navicular of *Mylodon* and in that of *Megalonyx*. The concavity on the proximal side is much deeper than in the navicular of *Megalonyx sierrensis*. The cuboid facet is narrow, flat or slightly convex, and confluent with the astragalar surface. It is, however, distinctly separated from the concave portion of the latter surface by a sharp angle, as in *Hapalops*. Along the outer half it is also confluent with the facet for the ectocuneiform.

[a]W. J. Sinclair. Additions to the fauna of the Lower Pliocene Snake Creek beds (Results of the Princeton University 1914 Expedition to Nebraska), Proc. Amer. Philos. Soc., vol. 54, p. 83, fig. 7, 1915.

The entocuneiform and mesocuneiform facets form a continuous articulating surface which may be separated by a median channel from the facet articulating with the ectocuneiform. These surfaces differ from those in *Megalonyx* and in *Hapalops* in the lack of decided divergence. As in *Megalonyx* and in the Miocene genus, the ectocuneiform facet has the greater area.

TABLE 42.—*Measurements (in millimeters) of navicular of N. shastense.*

	No. 1891–R–1	No. 1891–R–2	No. 1891–R–3	No. 1891–R–4	No. 1891–L–1	No. 1891–L–2
Greatest diameter between cuneiform facets (width)	64	61.5	66.9	64.6	65.8	65.2
Diameter taken at right angles to greatest diameter (dorso-palmar diameter)	51.5	49.5	54.2	51	51.2	50
Greatest thickness through convexity articulating with astragalus	33.7	28.8	31.7	28.4	32.2	32.5

ECTOCUNEIFORM.

In comparing the corresponding measurements, the ectocuneiform of *Nothrotherium* is seen to differ decidedly from that of *Megalonyx* in its smaller size. The ectocuneiform (fig. 34, A, B) is not deep and is relatively broader superiorly than that of *Megalonyx*. It differs from that of *Hapalops* in possessing a more narrow ventral lobe or projection. In this respect *Nothrotherium* is more like *Megalonyx*. The articulating surface on the distal side conforms in shape to the proximal surface of metatarsal III. It is broad

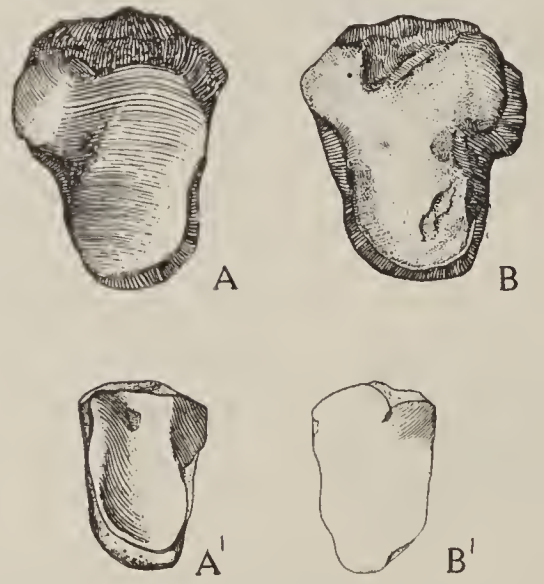

FIG. 34.—*Nothrotherium shastense* Sinclair. Left ectocuneiform, No. 1943-L-2. *A*, navicular view; *B*, mettarsal view. × 0.50. Rancho La Brea Pleistocene.

Hapalops elongatus Ameghino. Right ectocuneiform, No. 15160 P. U. C. A^1, B^1, same views as in *A*, *B*. × 1.0. Santa Cruz Miocene.

superiorly, with a tongue-shaped lobe extending inferiorly. In the ectocuneiform of *Hapalops elongatus* (No. 15160, Prin. Univ. Coll.) the lower lobe is much more broadly connected with the superior portion of the surface. The outer end of the upper portion is deflected decidedly to the proximal side and articulates with the fourth metatarsal. In other words, there is indicated a slight overlapping of the ectocuneiform on the fourth metatarsal, a character not seen in the pes of *Hapalops*.

Superiorly the ectocuneiform is twice as thick antero-posteriorly as it is inferiorly. The proximal surface articulating with the navicular varies in depth. The depth of the upper portion of the facet depends in part on the extent to which the outer margin has been turned back. The facet along the outer margin of its upper portion is continuous with a small articulating surface for the cuboid. In this respect *Nothrotherium* resembles *Hapalops* and *Megalonyx*. The facet for the cuboid faces outward as well as to the proximal side.

ENTOCUNEIFORM AND METATARSAL I.

Two specimens are available from Rancho La Brea, representing the first metatarsal with which the entocuneiform is evidently fused. Winge (1915, plate 25) has shown this element in the pes of *Nothrotherium maquinense*, and the material from the asphalt resembles this closely. The element (fig. 35, A, B, C) is thickened somewhat in the proximal region and thins toward the distal end. Along the external side are two facets: (1) a narrow surface, flanking the side of the terminal face, articulating with the mesocuneiform, and (2) a more distally situated surface articulating with the inner proximal facet of metatarsal II. The slightly concave facet at the proximal end, truncated along the outer side, articulates with the navicular. At the distal end no articulating surface is present, indicating an entire loss of the inner digit. This is a notable specialization beyond the stage seen in *Hapalops*, in which form the inner digit of the pes is still functional.

FIG. 35.—*Nothrotherium shastense* Sinclair. Right entoeuneiform and metatarsal I, No. 1880-R-2. *A*, ventral view; *B*, external view; *C*, dorsal view; *D*, proximal view showing these elements in artieulation with mesoeuneiform and metatarsal II; × 0.50. Raneho La Brea Pleistoeene.

It is evident from the above that the proximal part of the innermost element of the pes of *Nothrotherium*, bearing facets for the mesocuneiform and navicular, must be homologous with the entocuneiform. In both specimens from Rancho La Brea the entocuneiform has fused with the first metatarsal, whereas in the pes of *Hapalops* these elements were probably separate.

TABLE 43.—*Measurements (in millimeters) of ectocuneiform.*

	N. shastense, No. 1943–L–2	N. shastense, No. 1943–L–3	Hapalops elongatus, No. 15160 P. U. C.	Megalonyx jeffersonii (after Leidy).
Greatest depth	51.4	50.5	18.4	76.2
Greatest width	43.3	39.7	12.6	50.8
Greatest antero-posterior diameter superiorly	25.2	18.5	6.2	21.8

METATARSAL II.

In general shape the second metatarsal (fig. 36, A to F) of *Nothrotherium* is more like that of *Megalonyx* than like that of *Hapalops*. The largest of the second metatarsals from Rancho La Brea is still decidedly smaller than in *Megalonyx jeffersonii*. It is more slender than in *Hapalops elongatus*, in which respect it approaches *Megalonyx*. In the Miocene genus and in *Megalonyx* the depth of the proximal end exceeds the width, while in *Nothrotherium* the width in most specimens decidedly exceeds the depth. In the latter form the proximal end, when viewed from above, is seen in some specimens to extend beyond the end of the facet

TABLE 44.—*Measurements (in millimeters) of metatarsal I and entocuneiform of N. shastense.*

	No. 1880–R–1	No. 1880–R–2
Length	56.8	53.6
Width	30.3	33.5

for metatarsal III and even farther beyond the facet for the first metatarsal. In the metapodial of *Megalonyx* the outer and inner facets for the adjoining metatarsals are closer to the borders of the proximal articulation and do not stand off as distinctly as in that of *Nothrotherium*.

The mesocuneiform facet in *Nothrotherium* differs from that in *Hapalops* in its more distinct triangular shape, thus resembling that in *Megalonyx*. It also lacks the median dorsal notch present in the metapodial of the Miocene genus. The depth of the triangular facet is usually less than the length of the base (the dorsal border of the articulating surface).

A single element (No. 1881–R–2) of the three or more second metatarsals available from Rancho La Brea shows fusion with the mesocuneiform. The proximal surface in this specimen is concave, broad above and narrowing below, and articulates with the navicular. Continuous with this surface along the inner side, but at right angles to it, is a narrow facet (fig. 36 c) that articulates with a similar surface situated on the outer side of the entocuneiform.

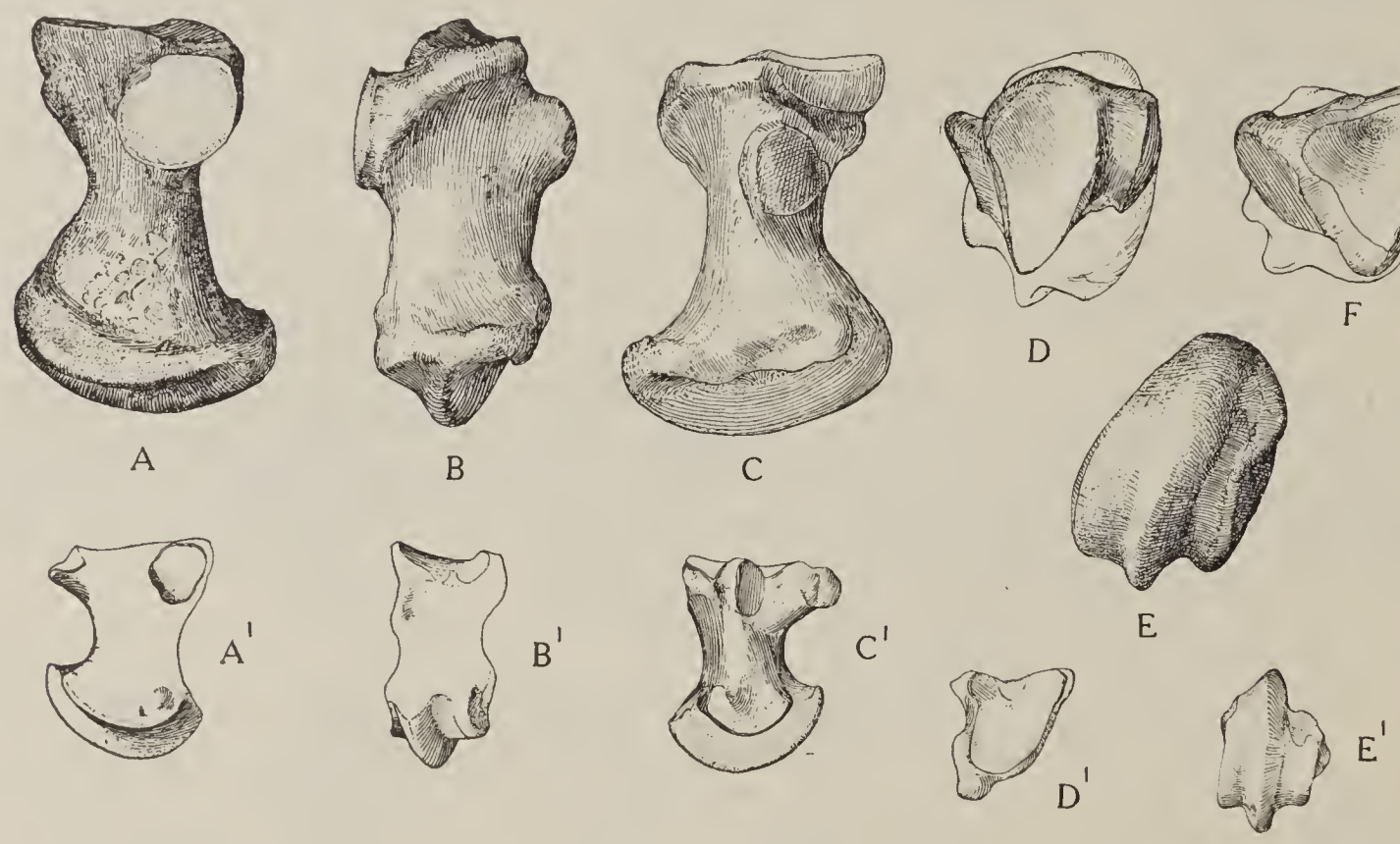

FIG. 36.—*Nothrotherium shastense* Sinclair. Right mesocuneiform and metatarsal II, No. 1881-R-2. *A*, outer view; *B*, dorsal view; *C*, inner view; *D*, proximal end; *E*, distal end; *F*, proximal end of metatarsal II, No. 1881-R-1; × 0.50. Rancho La Brea Pleistocene.

Hapalops elongatus Ameghino. Right metatarsal II, No. 15545, P. U. C. A^1, B^1, C^1, D^1, E^1, same view as in *A*, *B*, *C*, *D*, *E*. × 1.0. Santa Cruz Miocene.

The facet for metatarsal I is directed slightly downward and may be plane or slightly concave. The outer facet for metatarsal III may have its greatest diameter vertical or transverse with reference to the outer side. The surface is convex. In the corresponding metatarsal of *H. elongatus* (No. 15545, Prin. Univ. Coll.) this facet is concave and is not placed upon so distinct a pedicle as in the species from the asphalt beds. It articulated presumably with the ectocuneiform. The second metatarsal never overlapped the third at the proximal end, as in the Miocene *Eucholoeops* or *Analcimorphus*.

The shaft is broad, with the ventral surface rounded. The distal articulation, as in *Hapalops*, is placed somewhat oblique to a vertical plane of the shaft. It differs from that in the Miocene form in lacking the broad offset on the inner side of the carina. In the species from the asphalt there is an articulating offset along the outer side of the

carina, but along the inner side its place is taken by a narrow and more or less defined groove. Leidy (1855, p. 42) states that at the distal end of metatarsal II in *Megalonyx* there is "a long vertical, ellipsoidal articulating process, with a short vertical offset upon each side."

PHALANX I, DIGIT II, PES.

The first phalanx (fig. 37, A, B, C) is shortened antero-posteriorly, this distance being less than the depth of the proximal end. The greatest length of the phalanx is along the inner side. A deep vertical groove at the proximal end received the carina of the second metatarsal. The groove notches the ventral surface. It is bordered along nearly the entire outer side by an articulating surface. Below the latter face and on the ventral side is a facet for a sesamoid. The distal articulating surface is slightly

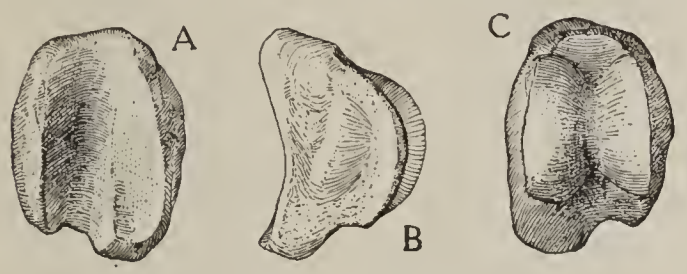

FIG. 37.—*Nothrotherium shastense* Sinclair. Right phalanx I, digit II, pes, No. 1886-R-1. *A*, proximal view; *B*, lateral view; *C*, distal view. × 0.50.

FIG. 38.—*Nothrotherium shastense* Sinclair. Phalanx II, digit II, pes, No. 1887-R-1. Proximal, lateral, and distal views. × 0.50. Rancho La Brea Pleistocene.

oblique to a vertical plane passing through the proximal groove. It consists of two condylar areas separated by a median V-shaped groove. The outer condyle has a slightly greater dorso-ventral extent than the inner condyle.

The measurements (in millimeters) of phalanx I, digit II, pes, of *N. shastense*, No. 1886–R–1, are: Length along inner side, 28.6; depth, 41.3; greatest width, 32.8.

PHALANX II, DIGIT II, PES.

The second phalanx (fig. 38) is not so long and slender as the corresponding segment in the second digit of the manus. It is presumably more comparable in size to the second phalanx of digit III, manus. The proximal articulation consists of two concave surfaces separated by a median acute ridge which widens below and above. At the distal end the two condyles diverge downward, with the outer of only slightly greater depth than the inner condyle. The surfaces of the condyles widen toward the inferior side.

The measurements (in millimeters) of phalanx II, digit II, pes, of *N. shastense*, No. 1887–R–1, are as follows: Length through middle, 50.9; width of proximal end, 27; depth of proximal end, 36.5; depth of distal end, 23.7.

PHALANX III, DIGIT II, PES.

The terminal phalanx of the second digit of the pes, as exemplified by specimen 1888–R–1, fig. 41*b*, may have a length equal to that of the corresponding phalanx in the manus, but the hooded region is deeper and the claw-process is narrower than in the latter. Compared with other ungual phalanges of the manus, No. 1888–R–1 is larger than that of the fourth digit but smaller than that carried by the median finger. No. 1888–R–1 is actually wider at the proximal end than phalanx III, digit III, manus (No. 1890–L–1). Here the articulating surfaces for the second phalanx tend to diverge ventrally and increase in width in this direction. In No. 1890–L–1, however, the dorso-ventral extent of the proximal articulating surfaces is greater, but they do not tend to diverge ventrally. The posterior overhanging process is relatively slender in contrast to that in No. 1890–L–1. The tip of the claw-process in No. 1888–R–1 does not extend so far below the horizontal plane of the subungual base as in No. 1890–L–1. In the ter-

minal phalanx of digit IV, manus, the anterior end of the claw-process does not extend below this horizontal plane. The dorsal surface of the projecting portion of the claw-process in No. 1888–R–1 is rounded. In No. 1890–L–1 and in the ungual phalanx of

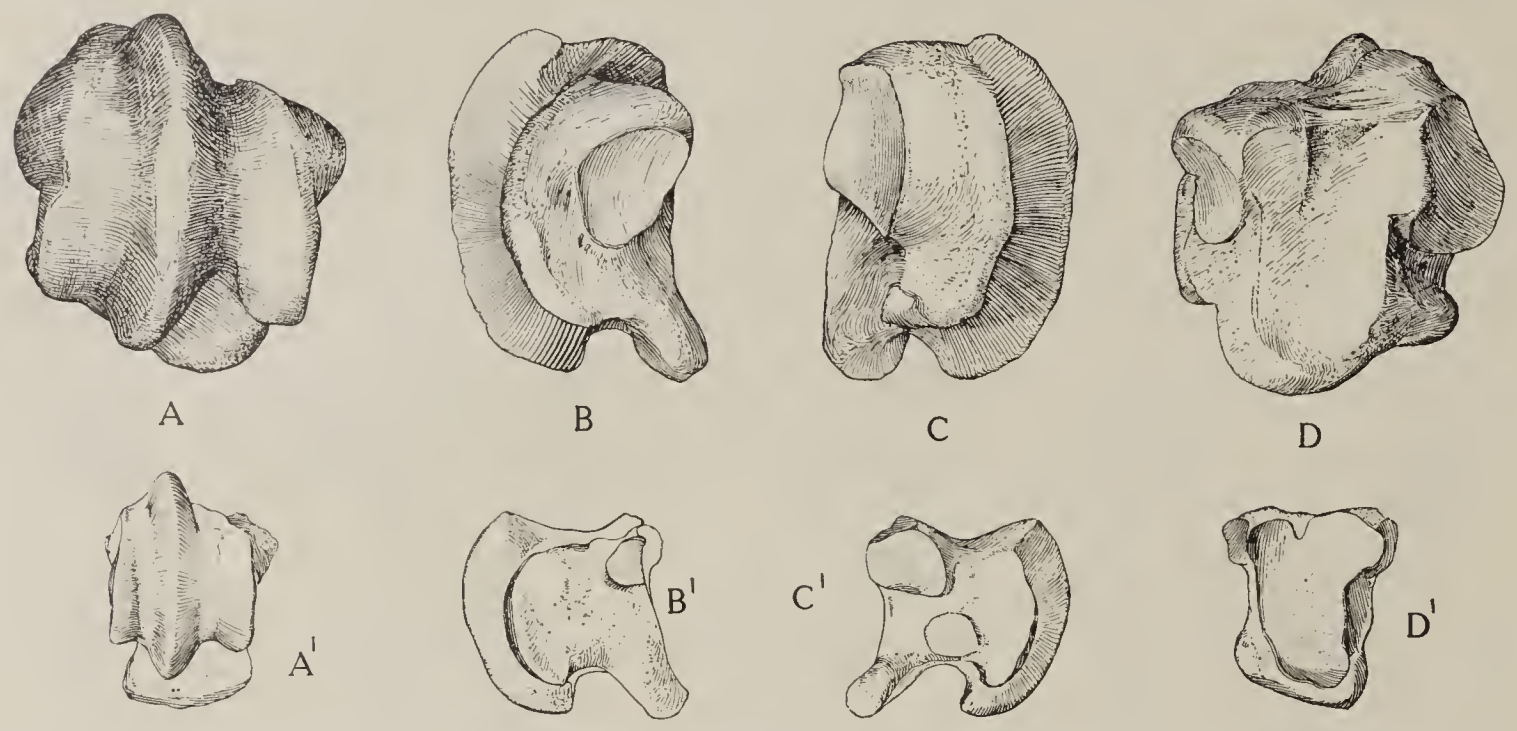

FIG. 39.—*Nothrotherium shastense* Sinclair. Right metatarsal III, No. 1882-R-1. *A*, distal view; *B*, inner view; *C*, outer view; *D*, proximal view. × 0.50. Rancho La Brea Pleistocene. *Hapalops elongatus* Ameghino. Right metatarsal III, No. 15545 P. U. C. A^1, B^1, C^1, D^1, same views as in *A*, *B*, *C*, *D*. × 1.0. Santa Cruz Miocene.

digit IV, manus, this portion of the dorsal surface forms a sharp edge. On the ventral surface of the base of the phalanx the discoid area for tendon attachment is situated forward. Lying on each side posterior to this area are the foramina for blood-vessels to the base of the claw. The inner foramen lies slightly in advance of the outer.

TABLE 45.—*Measurements (in millimeters) of second metatarsal.*

	Nothrotherium shastense, No. 1881–R–2[1]	N. shastense, No. 1881–R–1	N. shastense, No. 1881–R–4	Megalonyx jeffersonii, (after Leidy).
Greatest length	76.6	71.4	72.4	88.9
Greatest width of proximal end, from third metatarsal facet to first metatarsal facet	43.5	47.6	44.7	....
Greatest depth of proximal end	39	36.3	34.5	57.2
Least depth of shaft	21.3	20.6	20.8	....
Greatest depth of distal end	53.5	48.4	47	63.5
Greatest width of distal end	35.5	38	33.5	....

[1] Fused with mesocuneiform.

The measurements (in millimeters) of phalanx III, digit II, pes, of *N. shastense* (No. 1888–R–1) are as follows:

Greatest length from proximal end of overhanging process to tip of claw-process	106.3
Greatest depth from dorsal surface of hood to discoid area on ventral surface (approximate)	39
Width of proximal end	31
Length of subungual base	46
Width of ventral surface of claw-process just anterior to hooded region	13.3

METATARSAL III.

In *Nothrotherium*, as in *Megalonyx*, the width of metatarsal III is greater than the length, the Pleistocene genera differing in this respect from *Hapalops*. The element (fig. 39, A to D) is more compressed antero-posteriorly in *Nothrotherium* than in *Megalonyx*. The ectocuneiform surface is more deeply concave than in *Megalonyx* or in *Hapalops*, while the ventral, tongue-like process of the posterior end is not so broad as in *Megalonyx* or in *H. elongatus*. The inner facet for metatarsal II is concave, while the outer facet for metatarsal IV is less like *Megalonyx* and more like *Hapalops* in its large size. The latter articulating surface is directed more backward and less outward than in *Megalonyx* and in *H. elongatus*. At the distal end the trochlea resembles that in the Miocene genus. The carina is not so large and heavy as in *Megalonyx*.

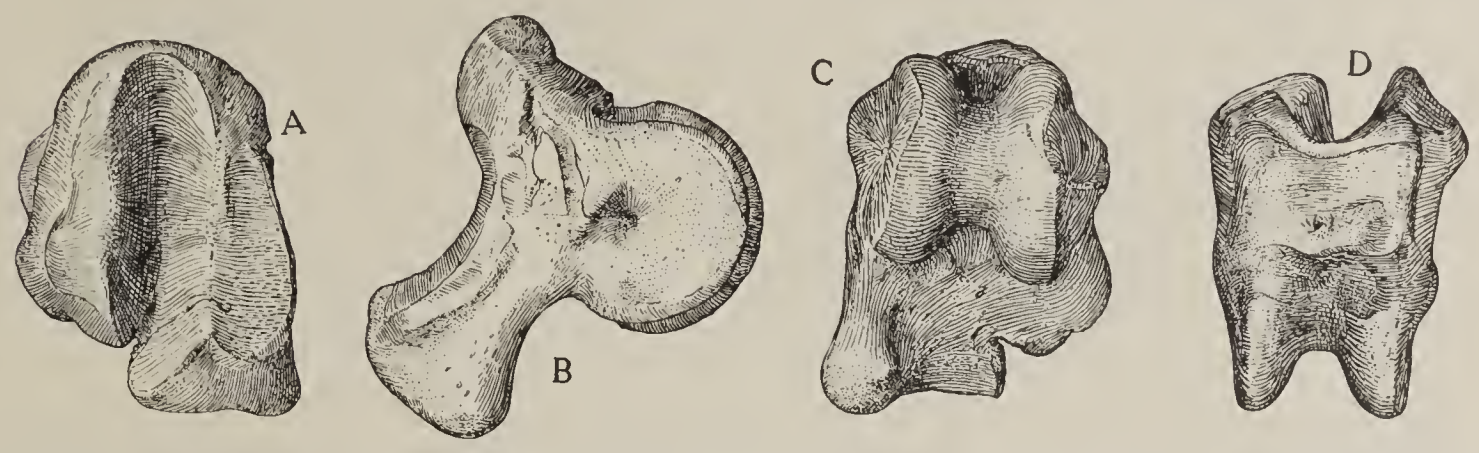

FIG. 40.—*Nothrotherium shastense* Sinclair. Co-ossified phalanges I and II, digit III, pes. *A*, *B*, *C*, No. 1889-L-2 with inner sesamoid bone. Proximal lateral and distal views. × 0.50. *D*, No. 1889-L-1. Dorsal view. × 0.50. Rancho La Brea Pleistocene.

CO-OSSIFIED PHALANGES I AND II, DIGIT III, PES.

In *Nothrotherium*, as in *Megalonyx*, the first and second phalanges of the median digit of the pes have fused to form a single element (fig. 40, A to D). Both Pleistocene genera are more advanced in this character than *Hapalops*, in which the phalanges are separate. The single element in *Nothrotherium* greatly resembles that in *Megalonyx*, but differs in its inferior size (compare measurements).

TABLE 46.—*Measurements (in millimeters) of metatarsal III, of N. shastense.*

	No. 1882–R–1	No. 1882–L–1
Antero-posterior diameter through middle	[1]43.4	[1]45.2
Greatest width	63.6	62.4
Greatest depth of proximal end	59	59.7
Depth of distal carina	67.6	62.5

[1] Approximate.

The proximal end is characterized by a deep median vertical groove with articulating offsets on each side as in *Megalonyx*. The furrow does not widen dorsally as in the latter genus. As in *Megalonyx*, the inner offset is the wider, but in *Nothrotherium* this articulating surface does not extend dorsally so far as the outer offset. In a single specimen from Rancho La Brea the inner sesamoid has fused with the lower side of the proximal end. The outer end of the sesamoid curves anteriorly. A facet on the inner side continues ventrally the articulating surface of the median furrow, while a posterior facet likewise continues downward the inner offset. As in *Megalonyx*, the inner sesamoid joins the co-ossified phalanges by a larger facet than does the outer sesamoid.

The distal condyles have relatively greater depth in the Rancho La Brea specimen than in Leidy's specimen of *Megalonyx jeffersonii*, and in dorsal view are seen to be separated by a wider groove. In the co-ossified first and second phalanges (No. 20004 U. C. C.), pes, of *Megalonyx* from Rancho La Brea, the groove of the distal trochlea is narrow above and widens below; in *Nothrotherium* it is practically of same width throughout. The outer condyle possesses greater depth than the inner. It is semicircular in outline, while the inner condyle presents a somewhat more extensive surface for articulation with the ungual phalanx.

TABLE 47.—*Measurements (in millimeters) of co-ossified phalanges I and II, digit III, pes, of N. shastense.*

	No. 1889–L–1	No. 1889–L–2
Length along middle of outer side	55.9	55.4
Greatest depth of proximal end	54.6	58.7
Depth of lateral condyle of distal end	41	43.8
Greatest width of proximal end	49.5	54
Depth of proximal end from superior border to median inferior border of sesamoid	....	69.7
Width of sesamoid	....	38.9
Thickness of sesamoid along inner side	....	20.6

PHALANX III, DIGIT III, PES.

The ungual phalanx carried by the median digit of the pes (fig. 41*a*) is the largest of the ungual series in *Nothrotherium*, being much larger than the corresponding phalanx of the median digit of the manus. The bony sheath is well preserved in specimens from the asphalt and encases more than one-half of the claw-process. The sheath is best developed along the sides. At the lower margin it may be separated from the side of the claw-process by a space measuring approximately 8 mm. The subungual base has a well-marked discoid area on its anterior half for tendon attachment. This area may become quite tuberous. Just posterior to it and on either side is a foramen transmitting blood-vessels to the base of the claw. The inner foramen is distinctly the larger. The dorsal surface of the claw-process within the bony hood is broadly convex. Anteriorly, however, this convex surface is transformed into a sharp dorsal edge which extends to the tip of the phalanx. The sides of the claw-process at the anterior margin of the hood are concave dorso-ventrally. The ventral surface of the process may be flat or slightly convex. It may vary in width.

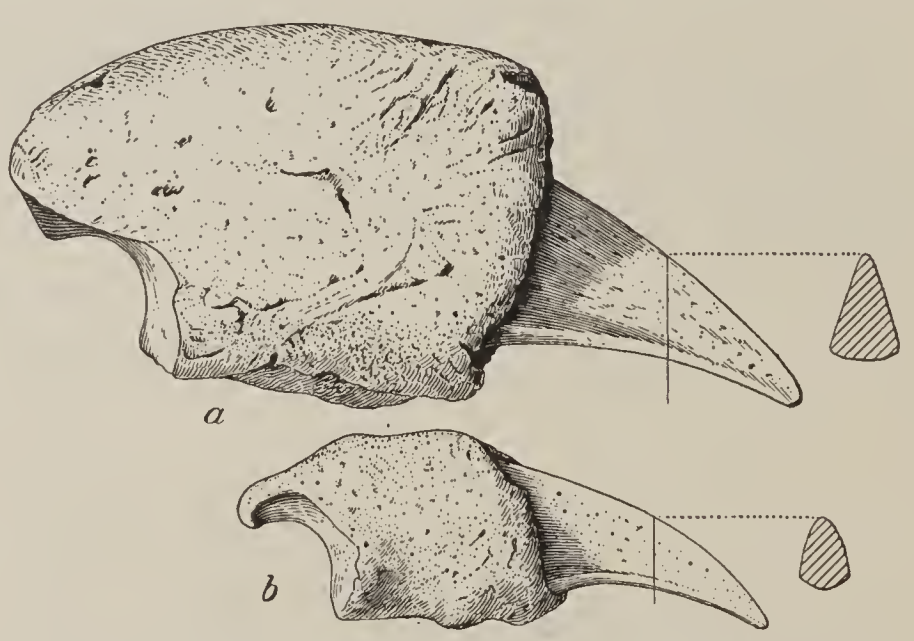

FIG. 41.—*Nothrotherium shastense* Sinclair. Ungual phalanges, right pes. Lateral view. × 0.50. *a*, digit III, No. 1890-R-1; *b*, digit II, No. 1888-R-1. Rancho La Brea Pleistocene.

The proximal articulation consists of two concavities extending parallel in a vertical direction and separated by a thick median ridge. The concavities are of equal width, but the outer has a slightly greater dorso-ventral extent. The articulations and median ridge extend upward and backward in an arch forming the lower surface of the overhanging process. The posterior end of this process is indented.

METATARSAL IV.

The fourth metatarsal of *Nothrotherium* (fig. 42, A to E) may be actually longer than that of *Megalonyx*, but the depth of the proximal end is not quite so great as in that of the latter genus. The proximal end (fig. 42D) is nearly quadrate in shape, lacking the pronounced downward prolongation which is present in the metatarsal of *Hapalops*. A

FIG. 42.—*Nothrotherium shastense* Sinclair. Right metatarsal IV, No. 1883-R-1. *A*, outer view; *B*, dorsal view; *C*, inner view; *D*, proximal end; *E*, distal end. × 0.50. Rancho La Brea Pleistocene.
Hapalops elongatus Ameghino. Right metatarsal IV, No. 15545 P. U. C. A^1, B^1, C^1, D^1, E^1, same views as in *A*, *B*, *C*, *D*, *E*. × 1.0. Santa Cruz Miocene.

small facet at the dorso-internal angle of the proximal face, not represented in *Megalonyx* or in *H. elongatus*, forms a lateral continuation of the ectocuneiform surface of metatarsal III. This ectocuneiform facet is separated by a broad interarticular channel from the large cuboid facet. On the inner side the ectocuneiform surface is continuous with an

TABLE 48.—*Measurements (in millimeters) of phalanx III, digit III, pes, of N. shastense.*

	No. 1890–R–1	No. 1890–R–2	No. 1890–R–3	No. 1890–R–4
Greatest length from posterior end of posterior process to tip of claw-process	161.8	[1]158.4	[1]161.3	165.8
Greatest depth from dorsal surface of hood to discoid area on subungual base	75.8	72.7	....	75.4
Width of proximal end	52.5	47.7	50.6	48.4
Greatest length of subungual base	69	67	68.7	72.9
Width of ventral surface of claw-process just anterior to hood	19.8	21.8	25.4	21.5

[1] Approximate.

articulating face for metatarsal III. The latter facet is convex antero-posteriorly and is situated more distally on the shaft than the facet for metatarsal V. The nearly flat cuboid surface is large and widens ventrally, differing in the latter respect from *Megalonyx*. It is less extensive than in *Hapalops*. The cuboid facet is separated from the

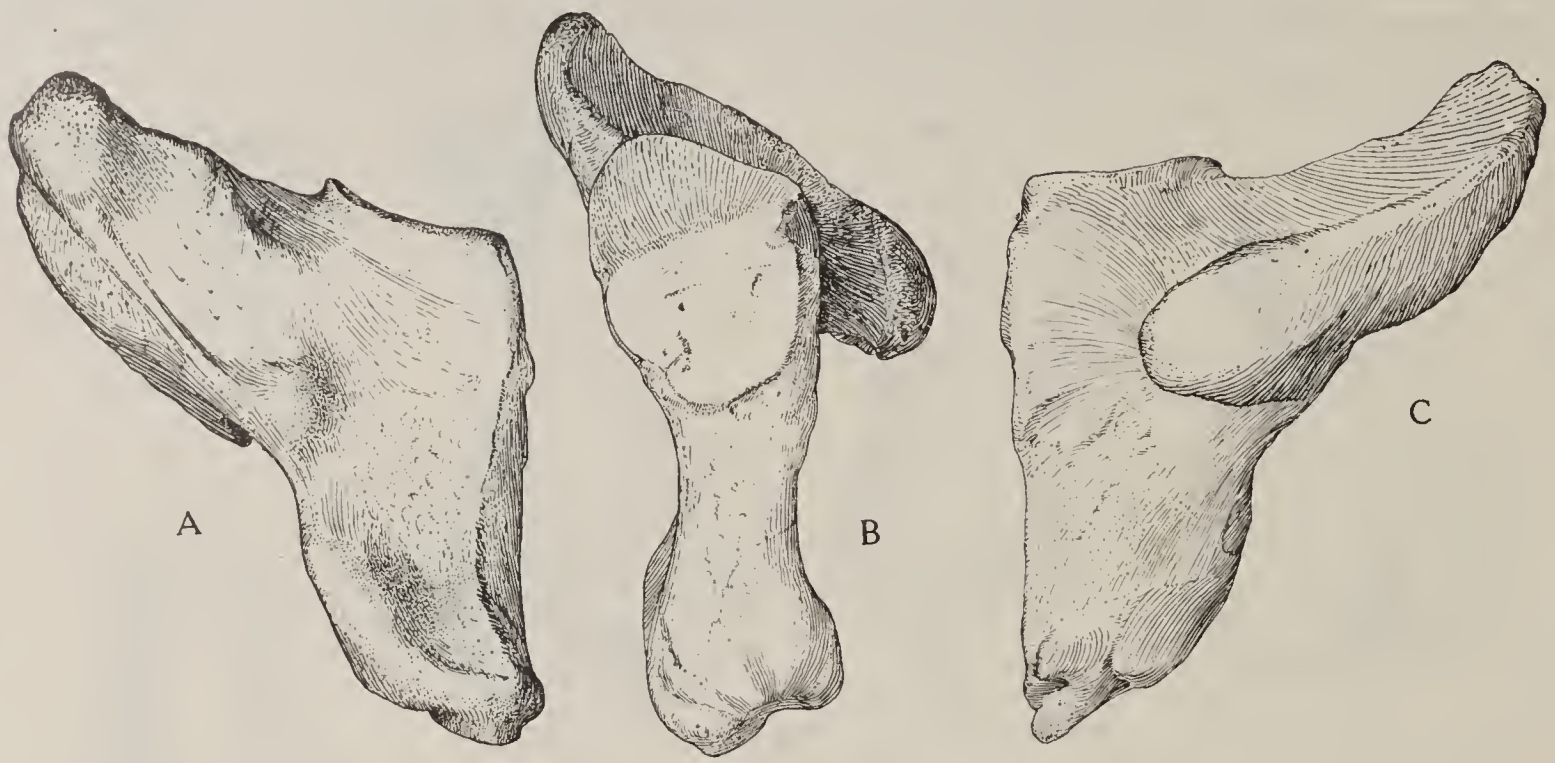

FIG. 43.—*Nothrotherium shastense* Sinclair. Right metatarsal V, No. 1884-R-1. *A*, dorsal view; *B*, inner view; *C*, ventral view. × 0.50. Rancho La Brea Pleistocene.
Hapalops elongatus Ameghino. Right metatarsal V, No. 15545 P. U. C. A^1, B^1, C^1, same views as in *A*, *B*, *C*, × 1.0. Santa Cruz Miocene.

large lateral facet for metatarsal V by a sharp angle, the degree of which is greater than that in *Hapalops*.

The shaft is well rounded internally, but the outer side is flattened more than in *Hapalops*. The distal extremity is expanded dorso-ventrally, but the articulating sur-

TABLE 49.—*Measurements (in millimeters) of metatarsal IV.*

	Nothrotherium shastense No. 1883–R–1	N. shastense No. 1883–R–2	N. shastense No. 1883–R–3	N. s. hawveri No.19875 U.C.C.
Greatest length	120	123	121.9	106.7
Greatest depth of proximal end	56.7	57.5	54	....
Greatest width of proximal end	51.2	58.2	50	49
Greatest depth of distal end	64.1	61	68.5	[1]67.7
Greatest width of distal end	43.3	42.4	40.3	40
Least depth of shaft	26.3	26.3	29	25

[1] Approximate.

face is much less developed than in either *Megalonyx* or in the Miocene genus. The dorso-external border of the metatarsal ends distally in a large tuberosity which surmounts the carina. The latter is decidedly less prominent than in either *Hapalops* or *Megalonyx*. It may be bordered along the inner, ventral side by a small offset. A small sesamoid facet is situated on the ventral and external side of the carina.

METATARSAL V.

The outermost metatarsal in the pes of *Nothrotherium* (fig. 43 A, B, C), in contrast to the corresponding metapodial of *Megalonyx* from Rancho La Brea, is a larger element and resembles in some respects the fifth metatarsal of *Hapalops* more closely than does the latter. The lateral process extends considerably beyond the facet for the cuboid, and the distal end of the lateral margin of this process extends downward, forming a decided ridge. In the deflection of the outer region of the lateral process, the metapodial differs noticeably from that of *Hapalops* (compare in fig. 43, C with C^1). The shaft is rather broad, deepest along the inner side, and narrowing gradually to the outer side. The articulating surface for the cuboid is slightly concave. The surface for metatarsal IV is also slightly concave and approaches in size the cuboid facet. The facets resemble in shape those in metatarsal V of *Megalonyx* and differ from those in the corresponding metapodial of *Hapalops*. At the distal end of the shaft a rounded ridge is formed, which joins with a rudimentary digit.

TABLE 50.—*Measurements (in millimeters) of metatarsal V, N. shastense, No. 1884–R–1.*

Length from union of proximal facets to distal end of shaft	107.7
Greatest width from union of proximal facets to outer border of lateral process	92.8
Greatest dorso-ventral extent of lateral process	100.3
Width of shaft distal to lateral process	43.4
Depth of proximal articulation	43.9
Depth of distal end	38.7

COMPARISON OF PES.

With the exception of the early representation of the metatarsal series of *Megalonyx jeffersonii* by Leidy (1860) and the reconstruction of the pes of *Nothrotherium maquinense* by Winge (1915), little information is available concerning the structure of the hind foot in Pleistocene Megalonychinae. More recently the incomplete information relating to the structure of the pes in *Nothrotherium* and in *Megalonyx* has been reviewed by Betty Schulthess (1920, pp. 102–105). The skeletal material from Rancho La Brea is sufficient to permit an almost complete reconstruction of the pes (plate 15) and offers opportunity to contrast adequately this part of the skeleton of the Pleistocene genus with that of the Upper Miocene *Hapalops*.

In general appearance, the pes of *Nothrotherium* is strongly suggestive of that of *Hapalops*. A number of specializations are, however, exhibited. The modifications have arisen as a result of change in position of the foot from a type resting with sole on the ground to one resting mainly on the outer side. Such a foot has deviated perhaps no less decidedly from that possessed by a primitive plantigrade mammal than has the hind foot of a digitigrade form. In one the original horizontal plane of the foot inclines forward, in the other it slopes principally to the outer side. *Nothrotherium* is not the only ground-sloth so characterized, for in *Mylodon* the hind foot exhibits similar deformation.

These ground-sloths and their related forms may be spoken of as *latero-pedal* types, employing the descriptive term to emphasize a character of the hind foot which undergoes progressive or rather retrogressive, change in the phylogenetic history of the group. Moreover, it should be recognized that in such a form as *Mylodon*, a change has also taken place in position of front foot, suggested by structural modifications in the digits similar to those seen in the digits of the hind foot.

As in *Mylodon harlani*, the lateral metapodials have been strengthened and the inner metatarsal has been reduced. The astragalus has been curiously modified in its articulation with the foreleg. The pes of *Hapalops*, as reconstructed by Scott, already shows a tendency to rest on the outer side, but the rotation has by no means progressed to the extent seen in *Nothrotherium*. The calcaneum in the Pleistocene genus has a fan-shaped posterior process similar to that in *Hapalops*, but lacking the great expansion seen in *Megalonyx*. The astragalus becomes deeper in the Pleistocene form, and the two divisions of the articulating surface for the tibia are bent at a sharp angle. In this respect the astragalus of *Megalonyx* is less specialized than that of *Nothrotherium* and is not greatly in advance of the type seen in *Hapalops*. In *Nothrotherium* the head of the astragalus, articulating with the navicular, has also greater individuality than that in *Hapalops*. In the distal row of tarsal elements there should be noted a more extensive articulation between cuboid and metatarsal V than exists in *Hapalops longiceps*.

In the series of metatarsals, No. I is rudimentary and has fused with the ento-cuneiform. In *Mylodon harlani* no element has been recognized as lying to the inner side of the mesocuneiform and representing perhaps the combined entocuneiform and metatarsal I. As in the pes of *H. longiceps*, metatarsal II is longer than metatarsal III, but distinctly shorter than either the fourth or fifth metapodials. With the exception of the inner metapodial, metatarsal III is the shortest of the series. There is close agreement between Miocene and Pleistocene forms in degree of divergence of metatarsal IV from metatarsal III. This divergence is greater than that between the corresponding elements of *Megalonyx* as shown by Leidy (1860, plate 6, fig. 1) and by the material referred to *Megalonyx* from Rancho La Brea. Metatarsal V resembles the corresponding metapodial of *Hapalops* more closely than does that of *Megalonyx*, particularly in the shape of the lateral process. The downward and inward deflection of the external border of the lateral process in *Nothrotherium* furnishes a broad support for the foot resting on its side and accompanies the change in position of the pes from that seen in *Hapalops*.

The hallux has disappeared entirely in *Nothrotherium*, while in *Hapalops* the toe is still functional. Digit II consists of three phalanges, of which the second is relatively longer and more slender than that in the pes of the Miocene genus. A more decided difference in size between the ungual phalanges borne by digits II and III exists in *Nothrotherium* than in *Hapalops*. In the latter, phalanges I and II of digit III are separate, while in *Nothrotherium*, as in *Megalonyx*, they have co-ossified to form a single element. Such co-ossification occurs occasionally in *Mylodon*. The co-ossification may be associated, perhaps, with the large claw-phalanx in the Pleistocene megalonychids. Metatarsal IV supported apparently such rudimentary elements as are present in the corresponding digit of *Mylodon*. In *Hapalops* the digit was apparently fully formed and functional. In specimens of metatarsal V from Rancho La Brea, a facet at the distal end indicates the presence of a nodule. In the reconstruction of *H. longiceps*, Scott shows a complete fifth digit in the pes.

CHARACTERS OF GENUS MEGALONYX.

Species of *Megalonyx* averaging larger in bulk than those of the genus *Nothrotherium*. Skull short, broad, and deep, with anterior end truncated. Mandible deep without spout-like predental region. Dentition $\frac{5}{4}, \frac{5}{4}$. First tooth separated by diastema from cheek-tooth series and cross-section is meniscoid with inner bulge. Last superior tooth tending to possess a triangular cross-section. Appendicular skeleton heavier than in *Nothrotherium*. Wing-like, posterior process of calcaneum broad; astragalus retains more the structure seen in *Hapalops* and is distinctly less modified than in *Nothrotherium*. Metatarsal IV short; metatarsal V with relatively slender lateral process.

GENUS MEGALONYX JEFFERSON.

Megalonyx. T. Jefferson, Trans. Amer. Philos. Soc. vol. 4, p. 248, 1799.

MEGALONYX JEFFERSONII CALIFORNICUS STOCK.

Megalonyx californicus Stock, Univ. Calif. Publ., Bull. Dept. Geol., vol. 7, p. 352, 1913.

DESCRIPTION OF MATERIAL.

It is an unusual character of the Rancho La Brea Pleistocene that relatively few individuals of the genus *Megalonyx* have been preserved. *Megalonyx* is decidedly less abundant in the asphalt beds than the genus *Mylodon* and occurs even more infrequently than the genus *Nothrotherium*. Not more than four or five individuals have been recorded. Unfortunately, the skull of *Megalonyx* is not available. The collection includes, however, the lower jaw and representative parts of the skeleton.

MANDIBLE.

The mandible (No. 21429, U. C. C., plate 17) is well preserved, lacking only portions of the coronoid processes. The specimen apparently belongs to an adult individual and is smaller than the lower jaw of *Megalonyx jeffersonii* described by Leidy (1855, pp. 13–15, plates 1 and 5). The horizontal ramus is deep and thick in the region of the cheek-teeth, while the vertical ramus is plate-like and resembles somewhat that portion in the lower jaw of *Mylodon*. At the anterior end a keel is developed along the upper half of the symphyseal region and on each side of the median ridge is situated a large mental foramen. Smaller foramina are also present. Behind the caniniform tooth the outer face of the horizontal ramus is deeply excavated along the upper half. The notch between the posterior border of the coronoid process and the condyle is relatively narrow, not wide as in *Megalonyx jeffersonii*. The condyle is large and is somewhat flattened dorsally. The heavy mandible of *Megalonyx* from Rancho La Brea is decidedly unlike the slender jaw of *Nothrotherium*. The latter difference is similar to that which exists between the Miocene genera *Eucholoeops* and *Hapalops*. In comparing the mandible of *Megalonyx* with that of *Eucholoeops* it should be noted that the anterior end does not extend in front of the caniniform teeth to the extent seen in the lower jaw of the Miocene genus. Between the caniniform tooth and the cheek-tooth series the dorsal portion of the ramus is narrower transversely in *Megalonyx* than in *Eucholoeops*.

DENTITION.

Dental formula: $\frac{5}{4}, \frac{5}{4}$.

The anterior tooth in the lower tooth-row is separated from the cheek-tooth series by a diastema. This tooth is comparable to that present in *Megalonyx jeffersonii* and possesses a convex external surface and an internal face which is developed into a convexity along the median line. The posterior face of the first cheek-tooth is wider transversely than the anterior face. Antero-posteriorly the tooth is widest toward the outer side and only faint grooves are indicated on the lateral surface. The second cheek-tooth is also widest antero-posteriorly toward the outer side. In contrast to the first cheek-tooth, the second narrows decidedly toward the inner side. The principal transverse axis of the third or last cheek-tooth is distinctly oblique to the fore-and-aft axis

of the tooth-row. The obliquity of this tooth with reference to the long axis of the tooth-row occurs not only in *Megalonyx*, but also in *Nothrotherium*, and seems to be characteristic of the Megalonychinae. The tooth corresponds in shape to that in *Nothrotherium* and the triturating surface wears in a similar way. The inner surface is round, while the outer face is practically flat.

Measurements (in millimeters) of mandible and lower dentition, No. 21429 U. C. C.

Length, anterior end of symphysis to posterior end of angle	287	Least distance between inner sides of second cheek-teeth	19.8
Length, anterior end of symphysis to posterior end of condyle	264.8	Anterior tooth, greatest diameter	35.5
Depth of ramus below middle of diastema	80.5	Anterior tooth, width normal to greatest diameter	16.5
Depth of ramus between first and second cheek-teeth	86	First inferior cheek-tooth, greatest transverse diameter	26.5
Depth of ramus at condyle	122	First inferior cheek-tooth, greatest antero-posterior diameter	18
Greatest width across outer sides of anterior teeth	89.6	Second inferior cheek-tooth, greatest transverse diameter	28.3
Width across second cheek-teeth	120	Second inferior cheek-tooth, greatest antero-posterior diameter	17.8
Width across outer ends of condyles	161.5	Third inferior cheek-tooth, greatest transverse diameter	26.2
Length of symphysis along inner side	91	Third inferior cheek-tooth, greatest antero-posterior diameter	20.7
Thickness of ramus below second cheek-tooth	49.5		
Length of diastema	42		
Length of lower dental series, anterior end of anterior tooth to posterior side of last cheek-tooth	137.3		
Length of lower cheek-tooth series	65		

In the lower dentition of *Eucholoeops*, the first or caniniform tooth is also separated from the cheek-teeth by a diastema. The tooth is either round or oval in cross-section and never assumes the shape seen in anterior teeth of *Megalonyx*. The two anterior cheek-teeth in *Eucholoeops* are oval, but with corners well rounded, in which respect they differ from the semi-quadrate teeth of *Megalonyx*. The third or last tooth in *Eucholoeops* is either round or oval, but the transverse axis is already oblique to the long axis of the tooth-row.

A single tooth (No. 6000–1, fig. 44, A, B) in the Los Angeles Museum, collected from Pit 77, apparently represents the superior fifth of the right side. Specimen 6000–1 differs from the last superior tooth of *Nothrotherium* in shape and in the large transverse diameter. The tooth approaches that of *Megalonyx* in size, but it is somewhat smaller and possesses a slightly different shape than the last superior tooth usually present in *Megalonyx jeffersonii*.

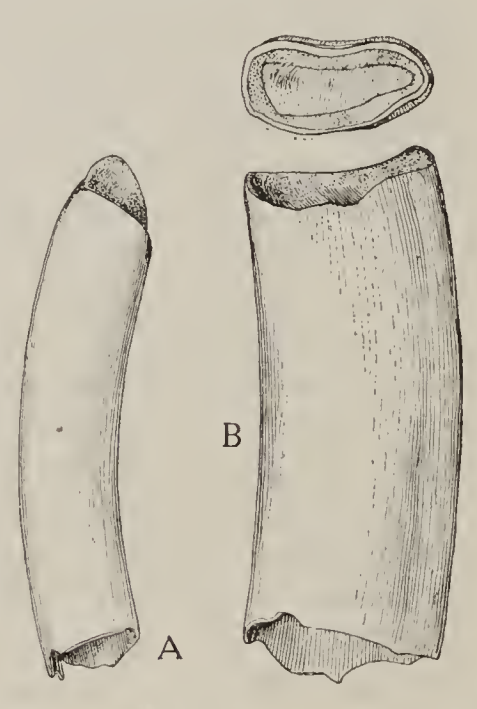

FIG. 44.—*Megalonyx* sp. *A* and *B*, fifth superior tooth, No. 6000–1. × 1.0. Rancho La Brea Pleistocene.

A striking resemblance exists between the Rancho La Brea specimen and a tooth described by Leidy (1855, pp. 45–46, plate 14, figs. 7, 8) from the Pleistocene near Natchez, Mississippi, as *Megalonyx dissimilis*. The two teeth agree very closely in size and are almost if not identical in shape. Both the Natchez specimen and the Rancho La Brea tooth differ in cross-section from the last superior tooth of *M. jeffersonii* in lacking a distinctly triangular outline. No. 6000–1 is of greatest antero-posterior diameter toward the lingual side, and for approximately two-thirds of the transverse distance there is no appreciable difference in this diameter. In the outer one-third the tooth narrows considerably, and in the corresponding region of the anterior face there is developed a shallow longitudinal groove. A broad and shallow longitudinal groove is present in median line on the posterior face. Anteriorly and internally the tooth is longitudinally concave.

The close similarity between No. 6000–1 from Rancho La Brea and the fifth superior tooth from near Natchez, Mississippi, indicates that perhaps the same specific form is represented. Whether these teeth are to be referred to a species distinct from *Megalonyx jeffersonii* is, however, another question. Cope (1899, p. 213) concluded from a

study of the superior cheek-teeth of *Megalonyx wheatleyi* that the last superior tooth varies somewhat in shape. Cope, therefore, does not regard the characters given by Leidy for *M. dissimilis* as of specific importance and states that the species is synonymous with *M. jeffersonii*.

VERTEBRAE.

Only a few vertebrae of *Megalonyx* (plate 19) are available from Rancho La Brea.

A single specimen of the first dorsal vertebra (No. 22111, U. C. C.) is available and lacks only the posterior epiphysis. The vertebra closely resembles the corresponding segment in *Nothrotherium* (plate 18, figs, 1, 1*a*, 2). In both forms the spine of the first dorsal is elongated, rising straight above the neural canal, and is thickened terminally, thus differing from the spine in the vertebra of *Mylodon*. The centrum is relatively not so long as in *Hapalops elongatus*. Remnants of the haemapophyses are to be seen on the ventral surface of the centrum. The transverse process as in *Nothrotherium* is more slender than in the Miocene species. There is no small canal perforating this process at the base of the metapophysis as in *Nothrotherium*. The concave articulating facet for the tubercle of the rib is quite large, while the surface for the capitulum is even smaller than that in *Nothrotherium*. The position of the facets is more like in the latter genus than in *H. elongatus*. The anterior zygapophyses are relatively much smaller than in *H. elongatus*.

TABLE 51.—*Measurements (in millimeters) of dorsal vertebrae.*

	No. 22111 U. C. C.	No. 24243 U. C. C.	No. 24244 U. C. C.
Length of centrum	[1]40	[1]50	57.7
Width of centrum measured over anterior face	46.1	59.8	76
Depth of centrum measured over anterior face	29.4	47.3	61.1
Width across metapophyses	90.4	....	....
Width across anterior zygapophyses	....	82.2	84.2
Greatest width across transverse processes	145.6	130.9	143.2
Length of neural arch along middle and at base of dorsal spine	50.8	67.7	72
Height, measured from middle of ventral border, posterior face of centrum to end of dorsal spine	[1]192	[1]185	214
Dorso-ventral diameter of neural canal, measured at anterior end	30	39.5	47
Transverse thickness of dorsal spine at middle	17.5	21.9	17.3
Transverse thickness of end of dorsal spine	32.8	36.8	43.5
Antero-posterior extent of end of dorsal spine	55.6	49	54.6

[1] Approximate.

Two additional dorsal vertebrae are available in the collections from Rancho La Brea now at the University of California. No. 24243 comes presumably from the anterior thoracic region, while No. 24244 belongs to the posterior part of the series. Both vertebrae are decidedly larger than corresponding segments in *Nothrotherium*, but resemble the latter fairly closely in shape. In each specimen the neural spine thickens considerably at the dorsal end. The anterior and posterior zygapophyses form rather large articulating surfaces.

TABLE 52.—*Measurements (in millimeters) of caudal vertebrae.*

	No. 6003–1	No. 6003–2
Length of centrum measured along ventral surface	38.2	34.6
Width of centrum measured over anterior face	52	48.2
Depth of centrum measured over anterior face	42.8	39.6
Width across transverse processes	116.3	105

Two caudal vertebrae, Nos. 6003–1, 6003–2, in the collections of the Los Angeles Museum (plate 18, figs. 7, 7*a*, 8, 8*a*) presumably belong to *Megalonyx*. Both specimens

lack a complete neural arch and apparently come from the posterior region of the caudal series. The specimens are much larger than posterior caudal vertebrae of *Nothrotherium* and differ from them considerably in shape. The centra are compressed antero-posteriorly, much more so than in caudal vertebrae of the latter genus. The anterior and posterior faces of the centrum in each vertebra are closer together dorsally than ventrally. The wing-like transverse processes are far better developed than in caudal vertebrae of *Nothrotherium*, in which the neural arch has been greatly reduced. The transverse processes in the specimens from the asphalt beds are thick posteriorly and have a decided slope forward and downward.

HUMERUS.

The humerus (No. 21003, U. C. C., plate 19) is close in structure to that of *Megalonyx jeffersonii* figured by Leidy. It is somewhat smaller, but this discrepancy in size may be due in part to a difference in age of the animals represented. In the specimen from the asphalt deposits the head has not fused entirely with the shaft, a separation which is not indicated in the humerus shown by Leidy. In anterior view (plate 19, fig. 1), the head is more prominently placed than in the humerus of *M. jeffersonii*. It is also more prominent than in the upper arm-bone of *Nothrotherium* (compare with plate 9, fig. 1). The head is also like that in *Hapalops* in its proportions—the antero-posterior diameter being decidedly greater than the transverse. In *Nothrotherium* the antero-posterior diameter is equal to the transverse diameter. As stated in the description of the humerus of *Nothrotherium*, the greater and lesser tuberosities are connected by a shelf of bone in front of the head, which is distinctly less developed in *Megalonyx*. In the latter genus, also, there is no deep gutter separating head from lesser tuberosity, as in *Nothrotherium*, in which respect *Megalonyx* is like *Hapalops*. The bicipital groove is narrower and deeper than in the humerus of *Nothrotherium*, but no deep channel traverses the anterior surface of the lesser tuberosity, as in the latter genus.

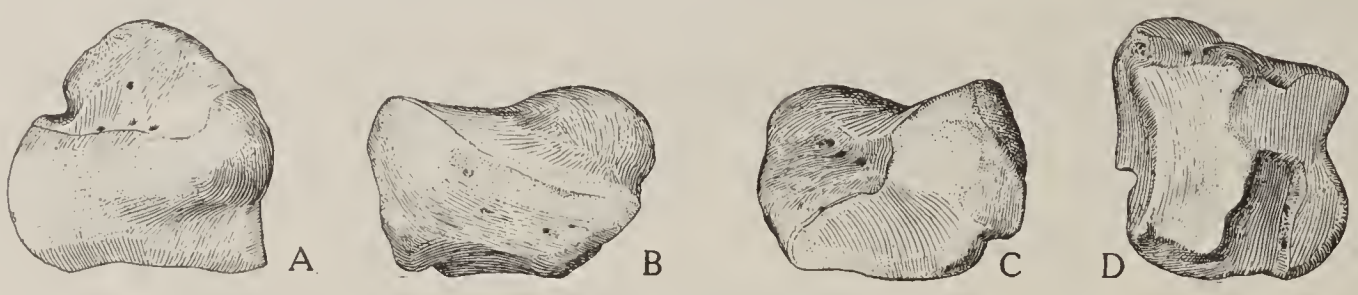

FIG. 45.—*Megalonyx jeffersonii californicus* Stock. Right unciform, No. 22775, U. C. C. *A*, proximal view; *B*, dorsal view; *C*, ventral view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

The pectoral and deltoid crests are both prominent features, and between them is situated a third ridge which is also distinct. This short middle ridge is present also in *Hapalops*. The deltoid crest swings well to the outer side of the shaft, much more so than in the humerus of *Nothrotherium*. An entepicondylar foramen is present, inclosed by a wide bar. The internal tuberosity is massive and supports on the superior surface a shallow but broad groove extending from the superior opening of the entepicondylar foramen to the outer extremity, and which near the outer end is completely arched by bone to form a closed canal (plate 19, fig. 2). The distal contour of the trochlea resembles that in *Megalonyx jeffersonii* and differs from that in *Hapalops* and *Nothrotherium*. The ulnar surface is wider transversely than in the humerus of the species described by Leidy. The surface is relatively wider antero-posteriorly than that in the humerus of *Nothrotherium*.

TABLE 53.—*Measurements (in millimeters) of humerus, No. 21003.*

Greatest length	447	Thickness of shaft at end of deltoid crest	59
Width at proximal tuberosities	128	Greatest width of distal expansion	221
Width of shaft at middle	81.3	Width of distal trochlea	127.5
Least width of shaft	60.5		

ULNA.

A single specimen of an ulna (No. 23192, U. C. C., plate 20) of *Megalonyx* probably represents the same individual to which the humerus belongs. In length it is some 43 mm. shorter than the ulna of *M. jeffersonii* described by Leidy and approximately 16 mm. longer than the ulna of *Nothrotherium*, also from Rancho La Brea.

The ulna possesses a much greater antero-posterior diameter than does the corresponding forearm element of *Nothrotherium*; but in transverse diameter it is, relatively and absolutely narrower. In greater antero-posterior diameter of shaft the ulna of *Megalonyx* is less like that of *Hapalops* than is that of *Nothrotherium*. Below the sigmoid notch the inner surface is deeply depressed, much more so than in the ulna of *Nothrotherium*. A large facet articulates with the radius. The olecranon process is relatively longer and narrower than that in the ulna of *Nothrotherium*. At the distal end the surface articulating with the carpus is more extensive than in *Nothrotherium*.

TABLE 54.—*Measurements (in millimeters) of ulna, No. 23192, U. C. C.*

Greatest length	464.6	Greatest width of shaft at distal end	74.3
Greatest width from summit of coronoid process	125.4	Thickness of distal articulating surface	46.6
Width of shaft at middle	69.2	Distance from summit of coronoid process to end of olecranon	152.3
Thickness of shaft at middle	33		

UNCIFORM.

The unciform (No. 22775, U. C. C., fig. 45, A to D) resembles very closely that described and figured by Leidy (1855, p. 32, plate 8, figs. 10, 12, 13 B) for *Megalonyx jeffersonii*. It is also quite similar in shape to the corresponding element in *Hapalops*. In dorso-palmar extent the unciform of *Hapalops* is deeper along the external side, but the dorso-internal angle is less prominent than in *Megalonyx*. With the inner ventral portion of the cuneiform surface forming a boss or knob, this surface is sigmoid in both the Miocene and Pleistocene forms.

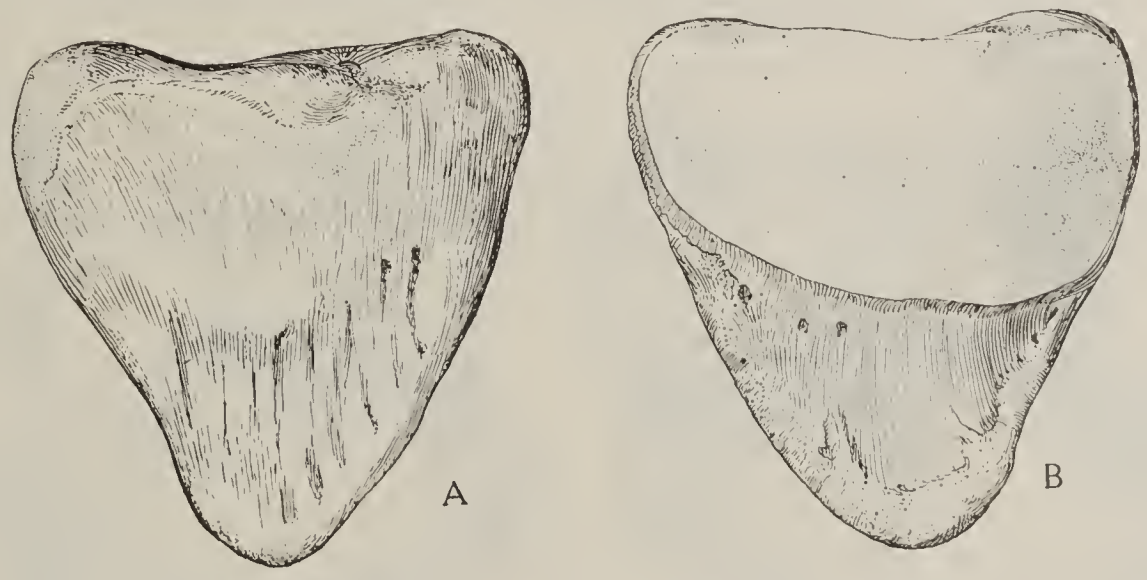

FIG. 46.—*Megalonyx jeffersonii californicus* Stock. Patella, No. 22776 U. C. C. *A*, anterior view; *B*, femoral view. × 0.50. Rancho La Brea Pleistocene.

The internal articulating face for the magnum resembles that in *Hapalops*, but is relatively somewhat less extensive. It is continuous along its proximal border with the cuneiform surface. In the Miocene genus the facet for metacarpal III is relatively wider than in *Megalonyx* and is grooved in its dorsal half, the furrow deeply notching the dorsal border of the distal end. The facet for metacarpal III in No. 22775 extends the whole dorso-palmar depth of the unciform, as in *M. jeffersonii*, but dorsally is not as wide as in the latter. Its dorsal border lacks entirely the notching noted in *Hapalops*. The facet is concave transversely in the lower half. The facet for metacarpal IV is larger than in *M. jeffersonii*. It is concave, but relatively not so deep as in the Miocene genus, and the facet is less extensive. The lateral facet for the fifth metacarpal occupies a position much as in *Hapalops*.

The measurements (in millimeters) of unciform (No. 22775) are: length, proximo-distal diameter, measured from plane of dorsal half of facet for metacarpal III to cuneiform surface, 35; width, 52.4; depth, dorso-palmar diameter, 46.9.

PATELLA.

Two specimens of the patella (fig. 46, A, B) are available, one in the collections of the Los Angeles Museum and another (No. 22776) in the collections of the University of California.

The knee-cap of the California form resembles closely that in *Megalonyx jeffersonii*, differing apparently only in minor details. The specimens from the asphalt beds are slightly smaller and approach more nearly a triangular shape than does the patella of the latter species as described by Leidy.

The patella of *Megalonyx* differs distinctly in shape from that of *Nothrotherium* (see plate 12, figs. 2 and 3). In *Megalonyx* the knee-cap is wide transversely and articulates with the femur by a broad surface. In *Nothrotherium* this facet is deep. The patella of *Megalonyx* resembles that of *Hapalops* closely in shape. In the Miocene genus the element is triangular, broad above where it articulates with the femur and narrowing below the femoral facet.

TABLE 55.—*Measurements (in millimeters) of patella.*

	No. 22776, U. C. C.	No. 6001–1 L. A. M.
Dorso-ventral diameter	106	109
Width	99	90.8
Dorso-ventral diameter of femoral surface	52	45.4
Transverse diameter of femoral surface	97.6	90
Thickness through femoral surface	42.2	41

CALCANEUM.

A well-preserved calcaneum of *Megalonyx*, No. 20095, U. C. C., from Rancho La Brea is shown in figure 47, A, B, C. No. 20095 resembles rather closely the corresponding element in *Megalonyx jeffersonii*. The specimen from the asphalt beds differs from

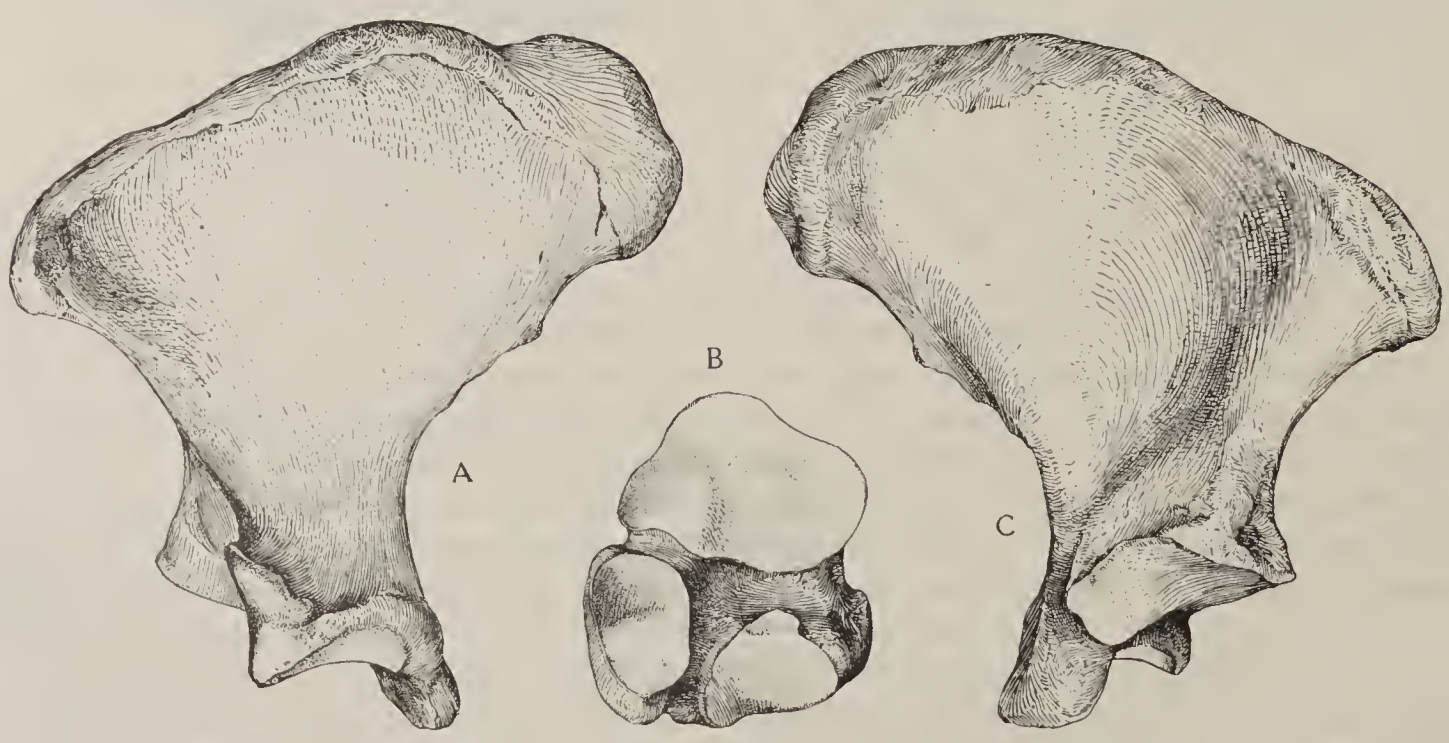

FIG. 47.—*Megalonyx jeffersonii californicus* Stock. Left calcaneum, No. 20095 U. C. C. *A*, outer view; *B*, view of articulating end; *C*, inner view. × 0.33. Rancho La Brea Pleistocene.

that of *Nothrotherium* (see p. 85, fig. 30, A, B, C) in having a short and broad neck and a great posterior expansion.

The articulating end is, on the whole, similar to that of *M. jeffersonii* and differs in shape from that of the calcaneum of *Nothrotherium* (compare fig. 30 B and fig. 47 B). The grooves separating the three articular facets are well defined. The groove between the large astragalar facet and that for the cuboid is particularly broad. The large astragalar facet is flat externally and becomes slightly concave internally and curves down to the inferior border. The small astragalar facet is concave in its longest diameter. The cuboidal facet is concave vertically and curves toward the external margin. The inner lip is flattened almost at right angles to the rest of the surface and articulates with the astragalus.

The measurements (in millimeters) of calcaneum, No. 20095, of *Megalonyx jeffersonii californicus* are as follows: width of neck, 67.8; greatest antero-posterior diameter, 206; greatest diameter of tuber calcis, 202; greatest thickness at posterior border, 38.2.

METATARSAL III AND DIGIT III.

The third metatarsal (No. 20001, U. C. C., fig. 48, A to D) differs from that in *Nothrotherium* in possessing greater antero-posterior length. The metapodial is, however, much less extended in this direction than is the corresponding element of *Hapalops*. The ecto-cuneiform surface is more constricted at the middle than in *Nothrotherium*, and the ventral process of the proximal end is broader. The facet for metatarsal II is flattened or slightly convex, with greatest diameter dorso-ventral. On the lateral side the facet for metatarsal IV has a smaller area, but is longer antero-posteriorly than in *Nothrotherium*. At the distal end the carina is much thicker than in *Nothrotherium* and resembles *Hapalops*. It has a large articulating offset along the inner side, which is especially broad dorsally. The offset along the outer side is narrower than in *Nothrotherium*.

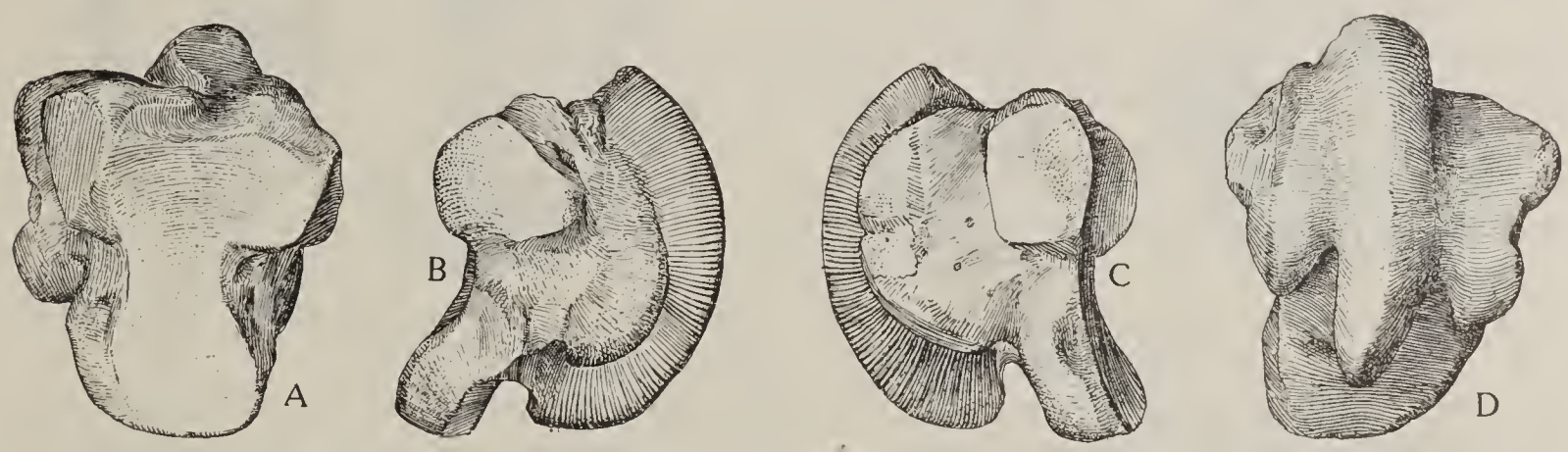

FIG. 48.—*Megalonyx jeffersonii californicus* Stock. Right metatarsal III, No. 20001 U. C. C. *A*, proximal view; *B*, outer view; *C*, inner view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

The element formed by the co-ossification of the first and second phalanges (No. 20004) of *Megalonyx* approaches that of *Nothrotherium* more closely in size than does that of *M. jeffersonii*. Some of the characters of this element have already been noted in a description of the corresponding segment of *Nothrotherium*. The ventral portion of the proximal extremity is much thicker antero-posteriorly than in *Nothrotherium*. At the distal end the median groove of the trochlea is narrower dorsally than in *M. jeffersonii*, and the dorsal depression is smaller. The lateral condyle is practically of same depth as in one of the specimens from Rancho La Brea belonging to *Nothrotherium*.

TABLE 56.—*Measurements (in millimeters) of metatarsal IV, No. 6002–1.*

Greatest length	93.4	Greatest depth of distal end	63.3
Greatest depth of proximal end	65	Greatest width of distal end	41.6
Greatest width of proximal end	49.4	Least depth of shaft	33.4

The ungual phalanx (No. 20004) is intermediate in size between the corresponding ungual phalanges of *M. jeffersonii* and *Nothrotherium*. In the Rancho La Brea specimen (C. Stock, 1913, p. 357, figures 17 and 18) the anterior portion of the claw-process, as well as part of the hood, is not preserved. The claw-process appears to be relatively more slender than in *Nothrotherium*. In both genera the claw is of the compressed type, differing thus from *Mylodon*. The bony sheath is thickest on the inner side. The basal discoid area is large. On each side posteriorly is a foramen with the larger on the inner side. The median ridge of the proximal articulating surface is thin above and widens below. It is much less robust than in *Nothrotherium*. The overhanging process is not so deeply depressed posteriorly as in the latter form.

METATARSAL IV.

The fourth metatarsal (No. 6002–1, fig. 49, A to D) is shorter than that of *Megalonyx jeffersonii*. It is decidedly shorter and heavier than the corresponding metatarsal of *Nothrotherium*. In this character the Rancho La Brea *Megalonyx* is less like *Hapalops* than is *Nothrotherium*. The proximal extremity has greater depth than in *Nothrotherium* and is more as in *Hapalops*. It is, however, more nearly rectangular in shape, due to a greater width ventrally. The cuboid facet has greater dorso-ventral extent and is narrower ventrally than in metatarsal IV of *Nothrotherium*. It is to a slight extent sigmoid dorso-ventrally, with the dorsal half well inclined toward the inner side. The proximal surface differs further from *Nothrotherium* in lacking a broad ectocuneiform facet.

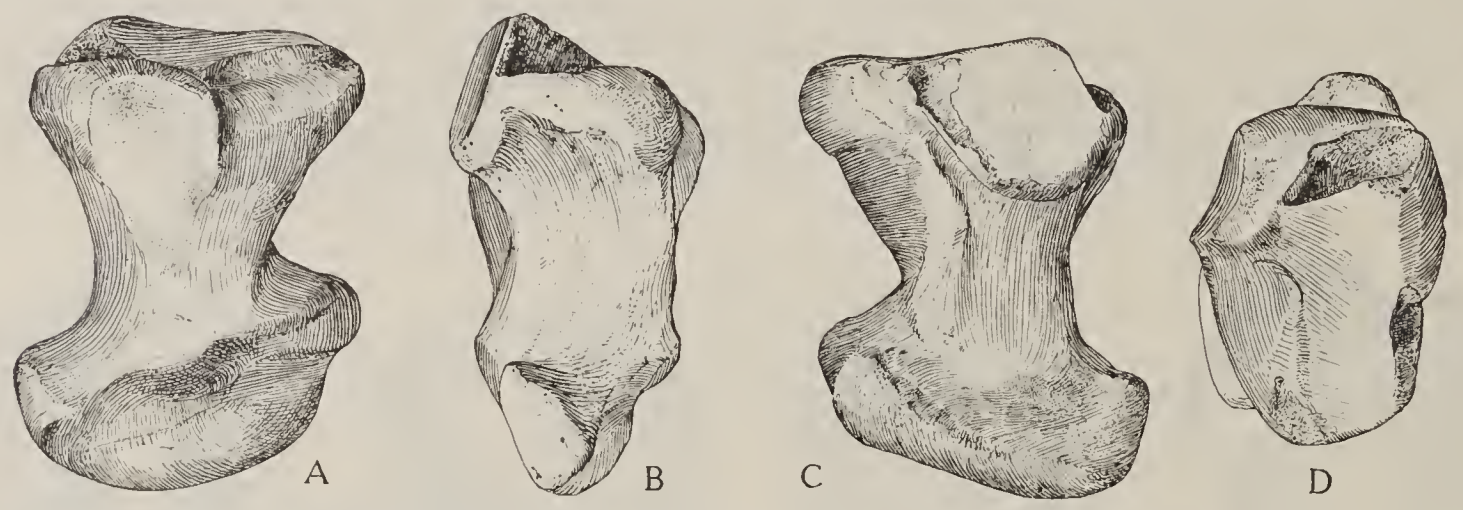

FIG. 49.—*Megalonyx jeffersonii californicus* Stock. Right metatarsal IV, No. 6002-1. *A*, inner view; *B*, dorsal view; *C*, outer view; *D*, proximal view. × 0.50. Rancho La Brea Pleistocene.

The facet for metatarsal III extends farther along the shaft than in *Nothrotherium*. The facet for metatarsal V, in contrast to that of *Nothrotherium*, is situated oblique to the longitudinal axis of the bone, whereas in the latter genus it parallels this axis.

The position of the facet for metatarsal V, together with the inwardly directed facet for the cuboid, may denote a greater divergence of the two outer metatarsals in *Megalonyx* than occurs in *Nothrotherium*. The shaft in the Rancho La Brea specimen is quadrate in section, with no development of a dorso-external crest. On the distal extremity the most prominent feature is the very thick carina, resembling that in *Hapalops* and differing from that in *Nothrotherium*. There is no offset along the outer side, while that along the inner side is much more reduced than in the Miocene form. The carina is not surmounted by such a heavy tuberosity as in *Nothrotherium*. A small facet for a sesamoid is present on the ventro-external side of the carina.

METATARSAL V.

A right and left metatarsal V (Nos. 22773, 22774) are in the collections of the University of California and probably belong to the same individual. The specimens from the asphalt beds are similar in shape, but smaller than the fifth metatarsal of *Megalonyx jeffersonii*. Metatarsal V (fig. 50, A, B) differs decidedly in shape from the corresponding metapodial of *Nothrotherium*. In general appearance this element in *Megalonyx* is less like that of *Hapalops* than is that of *Nothrotherium*. The lateral process in the Rancho La Brea specimen extends almost at right angles to the shaft, the outer end not reaching far, if at all, proximally beyond the articulating surface for the cuboid. In *Nothrotherium* the lateral process extends proximally considerably beyond this surface and the outer border forms a pronounced ridge beneath the element.

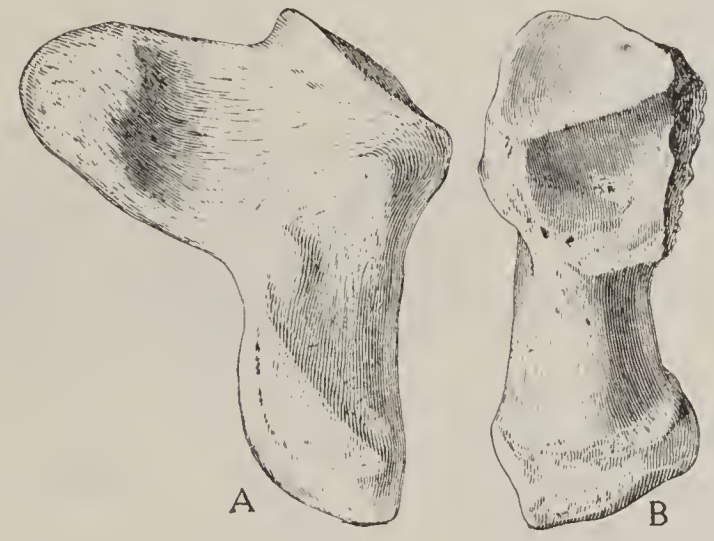

Fig. 50.—*Megalonyx jeffersonii californicus* Stock. Right metatarsal V, No. 22773 U. C. C. *A*, dorsal view; *B*, inner view. × 0.50. Rancho La Brea Pleistocene.

The shaft in *Megalonyx* is shorter and less plate-like than in *Nothrotherium*. The articulating surfaces for cuboid and metatarsal IV are subequal and are somewhat comparable in shape to the corresponding surfaces in *Nothrotherium*. Both *Megalonyx* and *Nothrotherium* differ in shape of these facets from *Hapalops*. In metatarsal V of the Miocene genus the articulating surfaces for cuboid and metatarsal IV are elongated dorsoventrally, the former being wide below and the latter being wide above. In *Megalonyx* the articulating surface for the rudimentary digit extends the full depth of the distal end of the shaft and is slightly convex.

TABLE 57.—*Measurements (in millimeters) of metatarsal V.*

	No. 22773, U. C. C., right.	No. 22774, U. C. C., left.
Length, from angle formed by proximal facets to distal end	85.1	85
Greatest width, from angle formed by proximal facets to outer border of lateral process	85.3	80.7
Width of lateral process	39.6	46.9
Width of shaft anterior to lateral process	32.3	32.5
Depth of proximal articulating end	46.9	45.9
Depth of distal end	40.2	39.7

OCCURRENCE AND DESCRIPTION OF MEGALONYCHINAE IN THE PLEISTOCENE OF WESTERN NORTH AMERICA.

GREAT BASIN PROVINCE.

White Bluffs, near Hanford, south central Washington.—The White Bluffs consist of a series of sedimentary deposits, probably of flood-plain origin, exposed in section several hundred feet in height along the eastern bank of the Columbia River, 12 miles above Pasco, Washington. The beds were examined by J. C. Merriam and J. P. Buwalda[a] and were designated the Ringold formation. The Ringold is regarded as Pleistocene in age. The following collection is listed from a locality in the Ringold formation near Hanford:

Megalonyx, small speeies, probably new.
Equus or Pliohippus, ealeaneum.
Camelid, small, near Pliauehenia.
Camelid, possibly larger than first-mentioned form.
Cervid, antler fragments.
Leporid, new genus.
Fish vertebrae and other elements of skeleton.
Testudo fragments.

It would be interesting to know the relationship of the White Bluffs fauna to that of the Washtuckna Lake Pleistocene, Franklin County, Washington, for the two localities are not very distantly separated. Horses, camels, and deer occur at both localities, but *Mylodon* is the ground-sloth recorded from Washtuckna Lake.

A fragmentary portion of the skull with right upper cheek-tooth series (No. 22779, fig. 52) and a single vertebra (No. 24118) from localities 3031 and 3031B, respectively, in the White Bluffs near Hanford, Washington, represent the specimens available.

DESCRIPTION OF GROUND-SLOTH MATERIAL FROM WHITE BLUFFS NEAR HANFORD.

In the skull-fragment (No. 22779 U. C. C.) some of the suture lines are still well defined and the specimen may not belong to a fully mature individual. Judging from specimen, the ground-sloth from the White Bluffs was of slightly smaller size than *Megalonyx wheatleyi* and approximately two-thirds the size of an adult individual of the species *M. jeffersonii.*

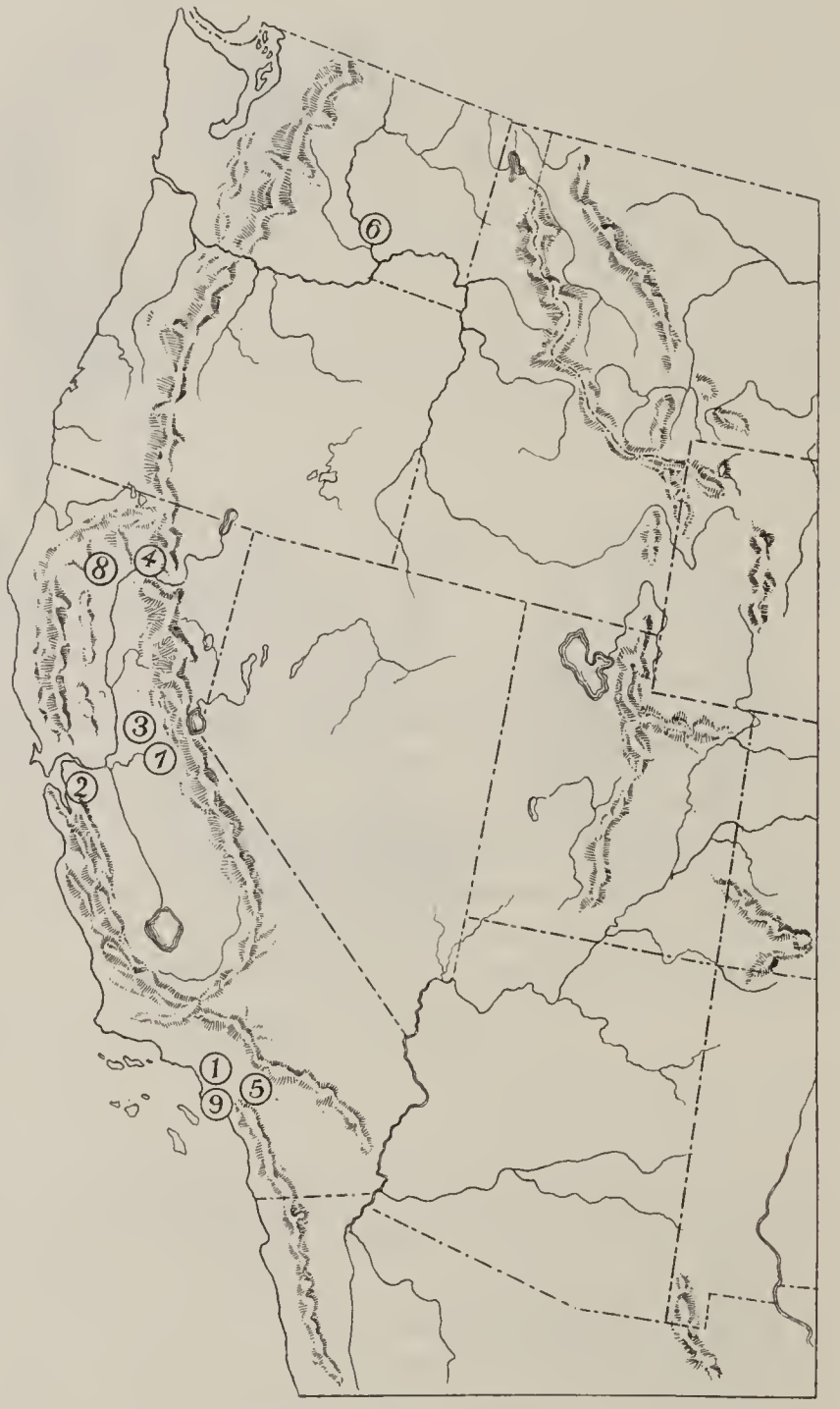

FIG. 51.—Map showing occurrences of Pleistocene Megalonychinae in western North America. 1, Rancho La Brea; 2, Alameda County; 3, Hawver Cave, Eldorado County; 4, Potter Creek Cave and Samwel Cave, Shasta County; 5, Bautista Creek Badlands, Riverside County; 6, White Bluffs near Hanford, south central Washington; 7, Murphys, Calaveras County; 8, Douglas City, Trinity County; 9, San Pedro, Los Angeles County.

[a]J. C. Merriam and J. P. Buwalda. Age of strata referred to the Ellensburg formation in the White Bluffs of the Columbia River. Univ. Calif. Publ., Bull. Dept. Geol., vol. 10, pp. 255–266, plate 13, 1917.

The cheek-teeth of No. 22779 (fig. 52) resemble in their general characters those of other Pleistocene species of *Megalonyx*. They are smaller than corresponding teeth of *M. wheatleyi* and of *M. leidyi*, but are slightly larger than those of *Nothrotherium*. The first cheek-tooth is wider externally than that shown by Leidy (1855, plate 3) in ventral view of the skull of *M. jeffersonii*. In Leidy's specimen the anterior face of the tooth seems to round into the postero-external face, while in No. 22779 a distinct outer flat

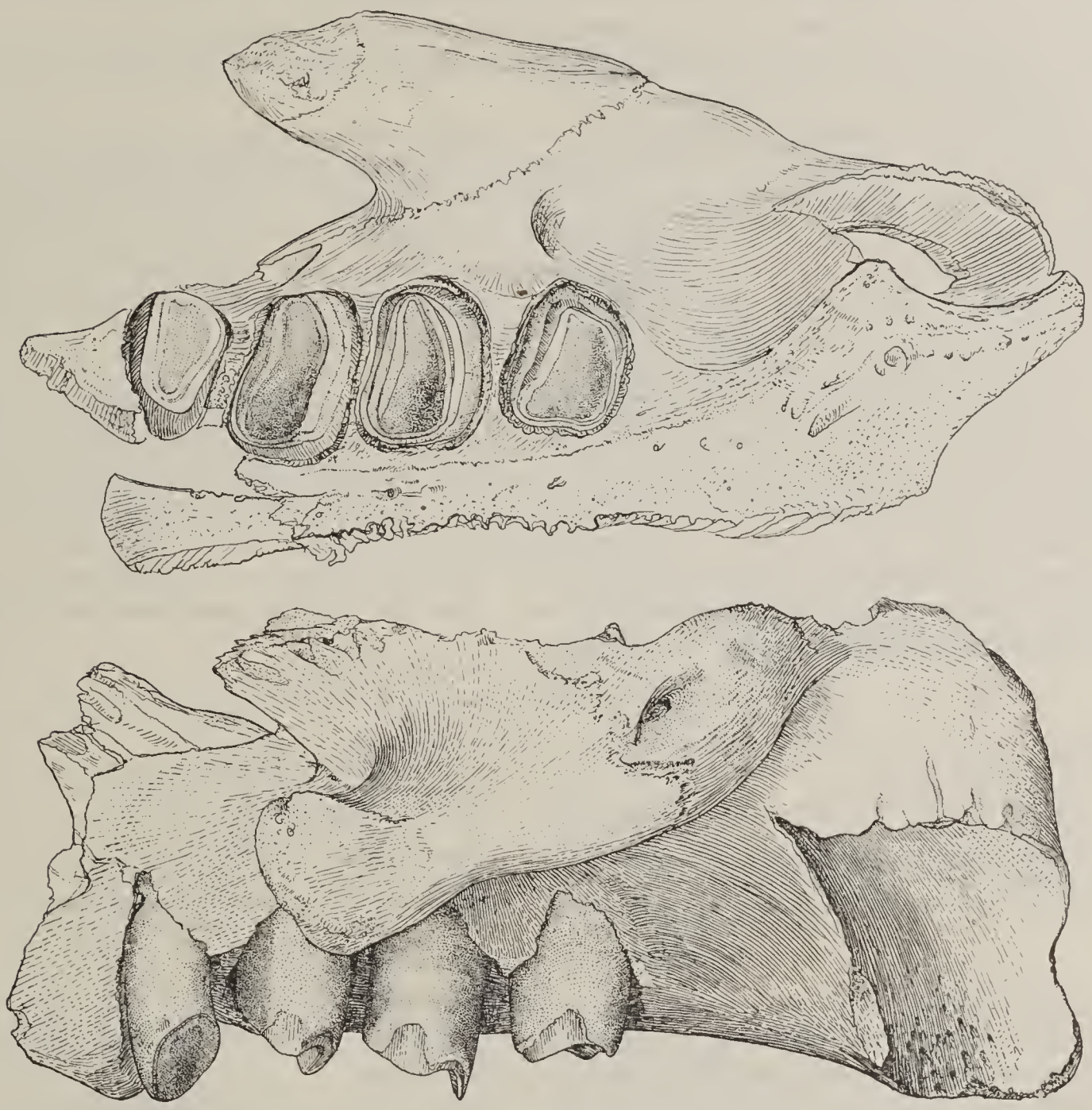

FIG. 52.—*Megalonyx* sp. Skull-fragment with superior cheek-teeth of right side. × 1.0. White Bluffs, near Hanford, Washington.

face is developed. The tooth resembles more that in the specimen of *M. jeffersonii* shown as figure 1 on plate 6 of Leidy's memoir. The last cheek-tooth of No. 22779 resembles more the corresponding tooth of other species of *Megalonyx* than it does that of *Nothrotherium*. The tooth in the species from the White Bluffs differs, however, from that of *M. jeffersonii*, *M. wheatleyi*, and *M. leidyi* in greater width of internal or medial side. In *Nothrotherium* this tooth is subject to some variation in shape.

A single vertebra (No. 24118, from Univ. Calif. Coll., Loc. 3031B) is the only additional specimen of the ground-sloth available from the White Bluffs Pleistocene. The vertebra belongs to the caudal series, but unfortunately lacks the neural arch and the

greater portions of the transverse processes. The anterior and posterior epiphyses are thoroughly fused with the body of the vertebra. The antero-posterior diameter of the centrum is slightly less than the transverse diameter. Two nutritive foramina, one on each side of the median line, are present on the dorsal surface of the centrum, while the ventral surface at about the middle is perforated by a single foramen. In caudal vertebrae of *Nothrotherium* several foramina are present ventrally. A well-defined canal on the ventral surface of the centrum leads backward and outward from each side of the middle foramen. This canal passes around the posterior side of the base of the transverse process and extends upward, forward, and inward to the nutritive foramina of the dorsal surface.

Two pairs of chevron facets were presumably present in No. 24118, but the articulating surfaces have been badly weathered. The two posterior surfaces are much larger than the two anterior and are situated close together. In the caudal series of *Nothrotherium* a decided difference in size between posterior and anterior chevron facets becomes noticeable in the sixth vertebra from the anterior end. The transverse process in No. 24118 is quite stout posteriorly, lessening in thickness toward the anterior side. The posterior side is situated much more closely to the posterior face of the centrum than in caudal vertebrae of *Nothrotherium*.

Characters possessed by the specimens from the White Bluffs Pleistocene indicate the presence of *Megalonyx*, but the type may be specifically separable from other known forms of the genus. As stated above, it is possible, however, that the individual represented by the skull-fragment may not be an adult. There is reason for believing, also, that the shape of the superior cheek-teeth, particularly that of the last upper tooth, may vary somewhat in megalonychid sloths, and in the present instance may not furnish a character of truly diagnostic value. Definite specific determination is therefore withheld and awaits fuller information.

TABLE 58.—*Measurements (in millimeters).*

Dentition, No. 22779:	
Length of cheek-tooth series, from anterior face of $\underline{2}$ to posterior face of $\underline{5}$	58.8
$\underline{2}$, greatest antero-posterior diameter	12.7
$\underline{2}$, greatest transverse diameter	14.8
$\underline{3}$, greatest antero-posterior diameter	13.3
$\underline{3}$, greatest transverse diameter	18.2
$\underline{4}$, greatest antero-posterior diameter	12.6
Dentition, No. 22779—*Continued.*	
$\underline{4}$, greatest transverse diameter	18.4
$\underline{5}$, greatest antero-posterior diameter	9.1
$\underline{5}$, greatest transverse diameter	16.4
Caudal vertebra, No. 24118:	
Antero-posterior diameter of centrum	37
Transverse width across posterior face	41.8
Depth measured across middle of posterior face	34.3

PACIFIC COAST PROVINCE.

Douglas City, Trinity County.—A last inferior tooth of the right side (No. 6739, U. S. Nat. Mus.) was collected in 1910 by J. S. Diller. The label accompanying the specimen states that the locality is the Union Hill Mine.

Specimen 6739 is smaller than corresponding teeth of *Megalonyx jeffersonii*, but larger than comparable teeth of *Nothrotherium*. It approaches in dimensions the last inferior tooth of *Megalonyx sierrensis*. The top of the pulp-cavity is situated approximately 35 mm. below the triturating surface. No. 6739 possesses the characteristic shape seen in the last inferior tooth ($\overline{4}$) of *Megalonyx* and of *Nothrotherium*. The anterior and posterior faces show slight curvature in dorso-ventral extent. A well-marked groove traverses the length of the posterior face. The greatest transverse diameter is 23 mm.; greatest antero-posterior diameter, 18 mm.

Shasta and Eldorado Counties.—Limestone caves situated in the mountain belt of California, east and northeast of the Sacramento Valley, have yielded important Pleistocene mammalian faunas in which ground-sloths occur. The three principal caverns fur-

nishing vertebrate remains are Potter Creek Cave,[a] near Baird, on the McCloud River, in Shasta County; Samwel Cave,[b] on the McCloud, approximately 15 miles north of Baird; and Hawver Cave,[c] on the Middle Fork of the American River, 5 miles east of Auburn, Eldorado County, and approximately 150 miles southeast of the Shasta caves.

TABLE 59.—*Pleistocene mammalian faunas from three cave deposits of California.*

POTTER CREEK CAVE.

Scapanus latimanus (Bachman).
Antrozous pallidus pacificus C. H. Merriam.
‡Arctotherium simum Cope.
†Ursus, n. sp.
‡Aenocyon dirus (Leidy).
Vulpes cascadensis C. H. Merriam.
Urocyon cinereoargenteus townsendi C. H. Merriam.
Bassariscus astutus raptor (Baird).
Mustela arizonensis (Mearns).
†Spilogale, n. sp.
Mephitis occidentalis Baird.
Taxidea, n. sp. (?).
†Felis, probably n. sp.
†Felis, n. sp.
Lynx fasciatus Rafinesque.
Lynx fasciatus, n. subsp. (?).
Neotoma cinerea occidentalis Baird.
Microtus californicus (Peale).
†Thomomys microdon Sinclair.
Thomomys leucodon C. H. Merriam.
*Aplodontia californica fossilis Sinclair.
Marmota flaviventer (Audubon and Bachman).
Citellus beecheyi douglasi (Richardson).
Eutamias sp.
Callospermophilus chrysodeirus C. H. Merriam.
Sciurus douglasi albolimbatus Allen.
Sciuropterus alpinus klamathensis C. H. Merriam.
Sylvilagus auduboni (Baird).
‡Nothrotherium shastense Sinclair.
‡Megalonyx wheatleyi (?) Cope.
‡Megalonyx jeffersonii (?) (Desmarest).
‡Megalonyx, n. sp.
‡Megalonyx sp.
‡Camelid.
†Bison sp.
Odocoileus, sp. a.
Odocoileus, sp. b.
‡Euceratherium collinum Sinclair and Furlong.
Oreamnos americanus (Ord).
‡Platygonus (?), sp.
†Equus occidentalis Leidy.
†Equus pacificus Leidy.
‡Mammut americanum (Kerr).
†Elephas primigenius Blumenbach.

SAMWEL CAVE.

Ursus americanus Pallas.
†Ursus, n. sp.
Ursus sp.
Vulpes sp.
Urocyon cinereoargenteus townsendi C. H. Merriam.
Procyon, near lotor (Linnaeus).
Mustela arizonensis (Mearns).
Mustela sp.
Mephitis occidentalis Baird.
†Felis, probably n. sp.
Peromyscus maniculatus gambeli (Baird).
Neotoma cinerea occidentalis Baird.
Microtus californicus (Peale).
†Thomomys microdon Sinclair.
Thomomys leucodon C. H. Merriam.
Erethizon epixanthum Brandt.
*Aplodontia californica fossilis Sinclair.
Citellus beecheyi douglasi (Richardson).
Callospermophilus chrysodeirus C. H. Merriam.
Sciurus griseus fossilis Kellogg.
Sciurus douglasi albolimbatus Allen.
Sciuropterus alpinus klamathensis C. H. Merriam.
Castor subauratus Taylor.
Lepus washingtoni klamathensis C. H. Merriam.
Sylvilagus auduboni (Baird).
‡Nothrotherium shastense Sinclair.
‡Nothrotherium sp.
‡Megalonyx sp.
Odocoileus, sp. a.
Odocoileus, sp. b.
‡Euceratherium collinum Sinclair and Furlong.
‡Preptoceras sinclairi Furlong.
Oreamnos, sp.
†Equus occidentalis Leidy.
†Elephas sp.

HAWVER CAVE.

Scapanus, possibly n. sp.
Ursus sp.
‡Aenocyon, near dirus (Leidy).
Canis ochropus Eschscholtz.
Procyon psora Gray.
Mephitis occidentalis Baird.
‡Smilodon (?) sp.
†Felis hawveri Stock.
†Felis, probably n. sp.
Peromyscus boylei (Baird).
Neotoma fuscipes Baird.
Microtus sp.
Thomomys sp.
Aplodontia (?) sp.
Citellus beecheyi (Richardson).
†Lepus, probably n. sp.
‡Mylodon harlani Owen.
‡Megalonyx (?) sp.
‡Nothrotherium shastense hawveri Stock.
Odocoileus sp.
‡Euceratherium collinum (?) Sinclair and Furlong.
†Bison sp.
†Equus sp.
‡Mammut sp.

‡ Extinct genus. † Extinct species. * Extinct subspecies.

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[a] W. J. Sinclair. The exploration of Potter Creek Cave. Univ. Calif. Publ., Dept. Amer. Arch. and Ethnol., vol. 2 pp. 1–27, plates 1–14, 1904.

[b] E. L. Furlong. The exploration of Samwel Cave. Amer. Jour. Sci , ser. 4, vol. 22, pp. 235–247, 1906.

[c] C. Stock. The Pleistocene fauna of Hawver Cave. Univ. Calif. Publ., Bull. Dept. Geol., vol. 10, pp. 461–515, 1918.

We note the presence of the genus *Nothrotherium* in all three Pleistocene cave faunas. The type locality of the species *N. shastense* is Potter Creek Cave. *Megalonyx* is also present at Potter Creek Cave and at Samwel Cave and possibly at Hawver Cave. *Mylodon* is found only at the latter locality. The megalonychid ground-sloths are therefore characteristic of the cave faunas of California and are regarded as types commonly occurring in the foot-hill and more elevated regions of California during the Pleistocene. Associated with the ground-sloths in this environment, and perhaps even more characteristic of it, are the ungulates *Euceratherium* and *Preptoceras*.

FIG. 53.—*Nothrotherium shastense* Sinclair. Right metacarpal IV, No. 9443, U. C. C. *A*, inner view; *B*, dorsal view; *C*, outer view; *D*, proximal end; *E*, distal end. × 0.50. Samwel Cave Pleistocene, California.

Hapalops sp. Left metacarpal IV, No. 15171. P. U. C. A^1, B^1, C^1, D^1, E^1, same views as in *A*, *B*, *C*, *D*, *E*. × 1.0. Santa Cruz Miocene.

The mammalian assemblages from the cave deposits are probably not all of the same stage or division of the Pleistocene, but are to be distributed over a considerable time period. One of the important problems in the palaeontology of western North America awaiting solution is the succession of Pleistocene vertebrate life. It is safe to say that the large assemblages known from the California cave deposits form an important link in the chain of evidence partly constructed, and detailed comparisons between the cave forms and those occurring at Rancho La Brea should cast light on the age enigma of the southern asphalt beds.

The materials from the cave deposits consist mainly of fragments of skulls and skeletons and separate teeth. The type specimen of *Nothrotherium shastense* from Potter

Creek Cave is an incomplete right ramus of the mandible (No. 8422 U. C. C.) (Sinclair, 1905, pp. 153-155, plate 23). A number of teeth of this species are also available. In addition, teeth have been found that apparently represent several species of *Megalonyx*.

Teeth, a well-preserved scaphoid (No. 9437 U. C. C.), a fourth metacarpal (No. 9443 U. C. C.), and a navicular (No. 9371 U. C. C.) comprise the best material of *Nothrotherium* from Samwel Cave.

The fourth metacarpal (No. 9443, fig. 53, A to E) is similar in shape and in slenderness to the corresponding element in the Brazilian species of *Nothrotherium* shown by Winge (1915, plate 24). It is relatively more slender than that of *Megalonyx*. No. 9443 evidently belongs to an individual of rather advanced age.

In proportion to length of shaft, the proximal and distal ends are much deeper in *Megalonyx jeffersonii* than in No. 9443. The Samwel Cave specimen in this respect is more like the corresponding metacarpal of *Hapalops* (No. 15171, Prin. Univ. Coll.).

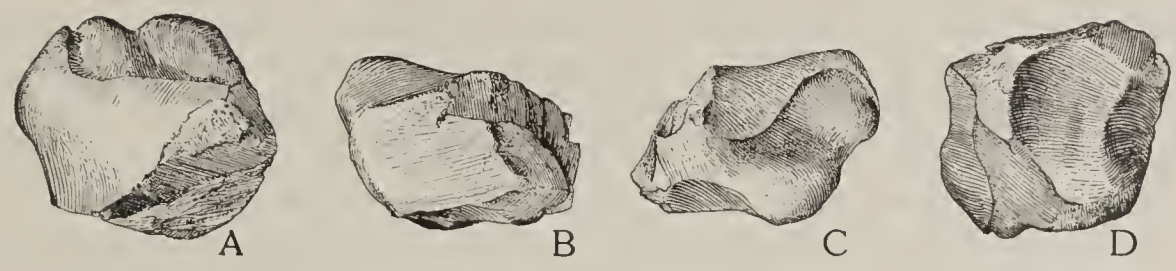


FIG. 54.—*Nothrotherium shastense hawveri* Stock. Left unciform, No. 22899 U. C. C. *A*, proximal view; *B*, dorsal view; *C*, ventral view; *D*, distal view. × 0.50. Hawver Cave Pleistocene, California.

The dorsal surface of the metacarpal near the proximal end is nearly flat and the carpal border rounds toward the inner side. In carpal view (fig. 53 D) the superior border of the proximal end in *Nothrotherium* is seen to be straight. In *Megalonyx jeffersonii* this border is somewhat convex. The palmar border in *Megalonyx* is drawn downward more than in *Nothrotherium*. The articulating surface for the unciform is relatively wider than in *Megalonyx*. It is continuous with the facet for the median metacarpal along the lower half of the carpal surface. Continuous with the unciform surface, but separated from it by a sharp angle, is the small, reniform facet for metacarpal V (fig. 53 C). This facet in the Samwel Cave specimen is more lateral in position than in *M. jeffersonii*. In *Nothrotherium* the surface for the unciform is sigmoid in dorso-palmar direction, but the articulating face for metacarpal III is flattened or somewhat concave. Both surfaces in the Miocene form are sigmoid in dorso-palmar direction. The facet for the median metacarpal in *Hapalops* is situated lower on metacarpal IV, so that the proximal end slopes as a whole obliquely inward from the outer side.

The shaft of the metacarpal is subquadrate, palmar and outer surfaces meeting in a sharp angle. The dorsal surface forms a sharp median ridge along approximately the distal two-thirds of the shaft, No. 9443 thus agreeing with metacarpal IV in the Brazilian species and differing from that in *Hapalops* and from that in *Megalonyx*. The distal articulation (fig. 53 E) is very close to that in *Hapalops* and in *Megalonyx*. The rather heavy carina is of nearly same thickness throughout. Along its entire inner side is an offset that widens below. The carina and the inner offset are deflected below for articulation with the sesamoid. The former is here transformed into a rather sharp ridge.

The measurements (in millimeters) of No. 9443 are: Greatest length, 129.8; greatest width of proximal end, 33; greatest depth of proximal end, 36; greatest width of distal end, 33; greatest depth of distal end, 51.

Some skull material, several teeth, and many parts of the skeleton of *Nothrotherium* are known from the Hawver Cave deposit (Stock, C., 1918, pp. 492–513, figs. 11 to 32*c*).

In the anterior extremity two elements are known that have not been found at Rancho La Brea.

An unciform (No. 22899) is nearly complete, lacking only the dorso-external portion, which has been broken away. This has destroyed the greater part of the facet for metacarpal V as well as some of the cuneiform surface, but the remaining facets are well preserved.

When viewed from the proximal end (fig. 54, A to D), the unciform of *Nothrotherium* approaches that of *Hapalops* rather more closely than does the unciform of *Megalonyx* in the expanse of bone at the ventro-external angle. The cuneiform surface does not form internally such a distinct boss or knob as in *Megalonyx*. This is due in part to the fact that the articulating surface slopes away more gradually from the top of the knob to the dorsal margin of the unciform. In *Megalonyx* a shelf is formed at the base of the knob and the end of this shelf is the dorsal margin. The proximal knob differs further from *Megalonyx* and *Hapalops* in being curiously flattened along the inner side. On the inner side the facet for the magnum resembles that in *Megalonyx* and is relatively less extensive than that in *Hapalops*. Dorsally a small facet for the magnum, continuous distally with the facet for metacarpal III, is not connected with the proximal articulating surface for the magnum as in the unciform (No. 22775 U. C. C.) of *Megalonyx* from Rancho La Brea. The facet for metacarpal III, is wide dorsally and narrows decidedly to the ventral side, thus resembling the corresponding feature in *Megalonyx jeffersonii* as figured by Leidy (1855, plate 8, fig. 13*b*) and differing from that in *Megalonyx* from Rancho La Brea. The widest portion of the facet differs from that in the latter genus in being deeply excavated, especially in an oblique line extending from the inner to the dorsal margin. In the unciform of *Hapalops*, the oblique groove traversing the facet dorsally is very much deeper than in *Nothrotherium* and notches the distal border of the carpal element. This deep groove is to be associated with a more extensive overlapping of metacarpal III upon the fourth metacarpal. In *Hapalops* the unciform joins with the external and internal sides of the overlapping processes, while in *Nothrotherium* articulation is with the external or true proximal face of the metacarpal.

In *Nothrotherium* the facet for metacarpal IV differs from the corresponding surface in *Hapalops* in its much smaller size, but resembles the latter in being deeply excavated. The facet in *Nothrotherium* is comparable in size to that in *M. jeffersonii*, but is decidedly smaller than in No. 22775 U. C. C., from Rancho La Brea. A small articulating facet, also for metacarpal IV, truncates the proximal portion of the boundary between facets for the third and fourth metacarpals.

The dorsal surface of the unciform (fig. 54 B) differs from that in *Megalonyx* in being wider proximo-distally along the inner side, and the dorso-internal corner is not as prominent.

A distal portion of a metapodial (No. 19861 U. C. C.) appears to belong to metacarpal III. In the specimen the shaft at the middle is nearly square in section, and is more slender than that of the corresponding metapodial of *Megalonyx* or of *Hapalops*. Its distal end is also not so large as that in the latter genus. The carina is nearly straight, thus differing somewhat from that in either the Miocene form or in *Megalonyx*. Articulating offsets are present along the lower half of each side of the distal carina.

The measurements (in millimeters) of metapodial, No. 19861 U. C. C., are: Greatest depth of distal end, 45.8; width of distal end, 31.

Calaveras County.—Mercer's Cave, near the town of Murphys, is located in the mid-Sierran region of California. Although of only minor faunal importance, the cavern is of interest as the type locality of the ground-sloth *Megalonyx sierrensis*, described by Sinclair (1905, pp. 155–160, plate 20, figs. 5 to 8; plate 21, figs. 1 and 2; plate 22, figs. 1 to 3).

The species is based on a lower jaw (No. 14986) in the Harvard Museum of Comparative Zoology, Cambridge, Massachusetts, and skeletal elements (No. 8130) in the collections of the University of California.

Middle California.—The genus *Morotherium* was established by Marsh (1874) on a fragmentary humerus and a nearly complete femur, said to have come from Pliocene strata (Pleistocene) of middle California. The type description follows:

MOROTHERIUM GIGAS, GEN. ET SP. NOV.

The present genus appears to be most nearly related to *Megalonyx* and *Mylodon*. From the former, as well as from *Scelidotherium*, it may readily be distinguished by the humerus, which has no supra-condylar foramen; while from the latter genus it differs in the femur, which is without a depression for the round ligament. The more slender femur and the concave ulnar articulation of the humerus separate it likewise from *Megatherium*. The skull of the present genus is not known.

In this species the femur is stout, and in its general proportions resembles that of *Megalonyx jeffersonii* Harlan. The head of the femur is hemispherical, but slightly expanded in an antero-posterior direction. The great trochanter is massive and rugose, and is raised slightly above the neck. It is somewhat recurved, and encloses a deep pit, as in the elephant. The third trochanter is represented only by a rugosity, mainly on the lower half of the shaft. On the posterior surface there is a prominent ridge extending from the great trochanter obliquely across the shaft toward the inner condyle. The trochlear surface for the patella is broad and shallow, and is separated by a deep groove from each of the condyles, the inner groove being about twice the width of the other. The humerus is expanded at its distal end. The olecranon cavity has little depth, and there is no perforation above the inner condyle. The latter has its articular face concave transversely, as in *Mylodon*. The outer and inner deltoid ridges unite below, terminating in a double tuberosity.

Measurements (in millimeters).

Length of femur	450	Width of trochlear surface	82
Transverse diameter at proximal end	217	Vertical extent	50
Antero-posterior diameter of head of femur	106	Transverse diameter of outer condyle	78
Transverse diameter	98	Least transverse diameter of shaft of humerus	93
Least transverse diameter of shaft	130	Antero-posterior diameter of ulnar condyle of humerus	70
Least antero-posterior diameter	55	Transverse diameter	63

In 1899, J. C. Merriam described a humerus from Pleistocene strata near Tomales Bay, California. It resembled closely the known portion of Marsh's specimen and was referred to *Morotherium*, although the validity of the genus was questioned by that writer. In 1914, Stock concluded that the humerus described by Merriam belongs to *Mylodon*. It is inferred, therefore, that Marsh's fragmentary specimen belongs also to this genus.

The femur of *Morotherium* was later stated by Marsh (1897) to be the type of the genus. In 1919 the writer examined this specimen (No. 11898) in the collections of the Peabody Museum, Yale University, and was impressed by its resemblance to the thigh bone of *Nothrotherium* from Rancho La Brea. Unfortunately, the only known femur, No. 1871–L–1, of *Nothrotherium* from the asphalt was not then available for direct comparison. Later a cast of the latter specimen was sent to Professor R. S. Lull, who, with his assistants, kindly made comparisons with Marsh's type. To quote from Professor Lull (letter dated June 28, 1922):

> "We have reached the conclusion that generic distinctions are not apparent, and that such differences as exist may be specific, and it is perhaps safer to assume that they are. On the other hand, they may be due to age or sex.
>
> "The differences are that the Marsh specimen is slightly larger, and has strong rugosities, some of which do not appear at all on your femur. In the latter, the head of the femur is not sharply separated from the neck, while in *Morotherium* it is larger and overhangs. The exterior distal face is larger, has greater curvature, and extends around the end as though to straighten the leg for greater weight in *Morotherium*, and the surface for the patella is wider transversely and not so curved. The loss of the inner condyle of the Marsh type leaves a certain element of doubt as to whether it was the same in both specimens."

As indicated by Professor Lull, Marsh's type is larger than the femur of *Nothrotherium* from Rancho La Brea. Judging from this character, Marsh's type might belong to

a species of *Megalonyx* smaller than *M. jeffersonii*. Small species of this genus are known to occur in the Pleistocene of western North America. There is reason for believing, however, that No. 1871–L–1 belonged to a younger individual than that represented by No. 11898. This becomes evident when the original femur from Rancho La Brea is examined, but can not be seen in the cast. In determining the relationship of *Nothrotherium* to *Morotherium* the following should be emphasized: (1) the type of *Morotherium* is a fragmentary specimen, (2) the geologic occurrence of No. 11898 is not definitely known, (3) certain structural characters in No. 11898, as pointed out by Lull, distinguish this specimen from the Rancho La Brea femur, (4) the femur of *Nothrotherium* shares in the general resemblance that exists between the skeletal elements of this genus and those of *Megalonyx*, and (5) only the femur of the large species *Megalonyx jeffersonii* is known; the comparable element in the smaller species of *Megalonyx* being unknown.

In view of the above the writer hesitates to assert definitely that Marsh's type, described under the name *Morotherium gigas*, represents the genus known as *Nothrotherium* and which occurs at Rancho La Brea. It seems more desirable to await further information concerning the femur of a fully matured individual of *Nothrotherium* and of femora belonging to the small species of *Megalonyx* known to occur in the Pleistocene of North America.

The name *Nothrotherium* was proposed by Richard Lydekker[a] to replace *Coelodon* Lund, a name preoccupied for a genus of long-horned, wood-boring beetles (Fam. Cerambycidae) from Senegal.[b] If the type specimen of *Morotherium gigas* is ultimately established as generically the same as *Nothrotherium*, then Marsh's name *Morotherium* has precedence over *Nothrotherium* Lydekker. Dr. T. S. Palmar (in a letter dated August 12, 1922) and Professor R. S. Lull concur with the writer in this conclusion.

San Pedro, Los Angeles County, California.—The San Pedro Pleistocene deposits are divisible, according to Ralph Arnold,[c] into an upper and a lower series, the division being based on the presence of an unconformity as well as differences in lithology, faunas, and inferred climatic conditions. Both the lower and upper San Pedro beds are very fossiliferous, the horizons yielding splendid marine invertebrate faunas. The Upper San Pedro deposits consist of sands and gravels and are presumably indicative of strand-line conditions. The beds have been involved in earth movements of the late Pleistocene or Recent, and are generally regarded as not representing the latest stage of the Pleistocene as recorded in this region of southern California. Fragmentary vertebrate remains occur in the Upper San Pedro in association with marine invertebrates. Interest attaches to the vertebrate collections because of light which may be thrown by them on the relationship of the upper San Pedro Pleistocene to the period of the Rancho La Brea accumulation. The following is a provisional list[d] of mammals comprising the Upper San Pedro fauna:

Canid (Aenocyon) (?) sp.
Felis, sp.
Sylvilagus sp.
Neotoma sp.
Citellus cf. beecheyi (Richardson).
Microtus, cf. californicus (Peale).
Thomomys bottae (Eydoux and Gervais).
Megalonyx sp.
Megalonychid (?) indet.
Equus, near occidentalis Leidy.
Odocoileus (?) sp.
Capromeryx, near minor Taylor.
Camelops hesternus (?) (Leidy).
Bison sp.

The ground-sloth remains consist of two specimens representing second phalanges. A specimen in the collections of the Los Angeles Museum exhibits the transversely compressed trochlea at the distal end, with deep median groove characteristic of *Megalonyx*. This phalanx is larger than second phalanges of *Megalonyx* known from Rancho

[a] Nicholson and Lydekker. Manual of palaeontology, ed. 3, vol. 2, p. 1299, 1889.
[b] Audinet-Serville. Ann. Soc. Entom. France, 1832, p. 164.
[c] Ralph Arnold. The palaeontology and stratigraphy of the marine Pliocene and Pleistocene of San Pedro, California. Mem. Calif. Acad. Sci., vol. III, 420 pp., 37 plates, 1903.
[d] Determination of the Pleistocene mammalian remains from San Pedro has been made with the assistance of Mr. Harold F. Blum. Material collected in Upper San Pedro beds exposed near yards of San Pedro Lumber Company.

La Brea. Its measurements (in millimeters) are as follows: Greatest length through middle of shaft 69.5; depth of proximal end 41.5; width of distal end 45.3.

The second specimen (No. 19720, U. C. C.) is long, narrow, and much less robust than second phalanges of *Mylodon* or *Megalonyx*. The shaft in No. 19720 is particularly long, while the distal articulation is small. The median groove of the distal trochlea is broad and rather shallow, differing in this respect from second phalanges of *Megalonyx* from Rancho La Brea and from Pleistocene cave deposits of California.

The specimen from the Upper San Pedro resembles somewhat the second phalanx, digit 2, manus of *Nothrotherium*, in being very long and slender. No. 19720 is, however, much larger than the phalanx in *Nothrotherium*. In *Megalonyx jeffersonii*, according to the figures given (Leidy, 1855, plate 10), phalanx II, digit II, manus, is stouter than the corresponding element in *Nothrotherium*.

The measurements (in millimeters) of No. 19729 U. C. C. are: Greatest length through middle of shaft, 73; depth of proximal end, 34.6; width of distal end, 23.2.

The horse, camel, and antelope remains from the Upper San Pedro may be comparable to those from Rancho La Brea and may indicate contemporaneity of the two faunas. While mylodont ground-sloths may be present in the Upper San Pedro mammalian fauna, the peculiarity remains that in the small and fragmentary collection from this horizon megalonychid ground-sloths are recognized. At Rancho La Brea, a locality not far removed from San Pedro, where Pleistocene mammalian remains are abundant and are well preserved, members of the Megalonychinae, and particularly individuals of *Megalonyx*, form a very small percentage of the total fauna. It is possible that phalanx No. 19720, U. C. C., may belong to a ground-sloth species or genus not heretofore recognized in Pleistocene deposits of the West. The presence of this specimen may be regarded as suggesting a faunal difference between the Upper San Pedro and Rancho La Brea.

Bautista Creek Badlands, Riverside County.—The Bautista Pleistocene deposits are typically exposed in the badlands along Bautista Creek, a tributary of the San Jacinto River, several miles southeast of Hemet, in southern California. The beds are stated by Childs Frick[a] to consist of fine and coarse sands and black clays that yield the following fauna:

Megalonyx (?) sp.
Lepus sp.
Odocoileus (?), two or more sp.
Capromeryx(?) sp.
Antilocapra (?) one or more sp.
Equus bautistensis Frick.
Tapirus merriami Frick.

An interesting member of this assemblage of mammals is the tapir. The horse, *E. bautistensis*, according to Frick, possesses apparently a tooth-pattern more specialized than that of *E. occidentalis*. Unfortunately the ground-sloth remains consist of a single specimen, a second phalanx belonging presumably to a megalonychid.

[a] C. Frick. Extinct vertebrate faunas of the badlands of Bautista Creek and San Timoteo Cañon, southern California. Univ. Calif. Publ., Bull. Dept. Geol., vol. 12, pp. 277–424, plates 43–50, 1921.

MYLODONTIDAE OF RANCHO LA BREA.

CHARACTERS OF FAMILY MYLODONTIDAE.

Hairy ground-sloths with dermal ossicles. Skull elongate with pre-orbital reigon short or long. Premaxillaries reduced, sometimes joined with nasals. Dentition $\frac{5-4}{4}$, $\frac{5-4}{4}$. Teeth round, oval, lozenge-shaped, or lobate. First tooth when present is caniniform and is not separated from cheek-teeth by long diastema. Last lower tooth bilobate, sometimes with median or third lobe present. Humerus with or without entepicondylar foramen; femur without third trochanter; manus with five digits, but digits I, IV, and V may be rudimentary; hallux absent and digits II, IV, and V may be rudimentary in the pes. Claw-processes of ungual phalanges broad and with convex dorsal surfaces.

TABLE 60.—*Measurements (in millimeters) of paired premaxillaries of Mylondon harlani.*

	No. 1711–3	No. 1711–1	No. 1711–2	No. 1711–4
Greatest transverse width	126.5	109.8	[1]120	[1]114
Greatest length of median arm	93.8	87.8	83.6	89
Greatest length of diverging arm measured from antero-internal angle to end	92	76.8	80.4	84.3

[1] Approximate.

CHARACTERS OF GENUS MYLODON.

Skull elongate but with short pre-orbital region, truncated anteriorly; dorsal surface of cranium flattened; premaxillaries small, loosely joined with maxillaries; malar vertically expanded and palmate; pterygoid plate-like; cranial elements around brain-chamber with many sinuses. Mandible deep. Teeth of the mylodont type. Lumbar vertebrae ankylosed with sacral vertebrae; haemapophyses are Y-shaped; humerus without entepicondylar foramen; manus with digits IV and V rudimentary. Pelvis with greatly expanded ilia; pubic symphysis short. Femur long and broad and without third trochanter; foreleg much shortened; pes with hallux completely reduced and with digits IV and V rudimentary. Calcaneum and metatarsal V enlarged. Largest ungual phalanx in digit III, manus; second largest in digit II, manus.

GENUS MYLODON OWEN.

MEGALONYX. R. Harlan, Medical and physical researches, p. 334, 1835.
MYLODON. R. Owen, The zoology of the voyage of H. M. S. *Beagle*, etc. Part 1, Fossil Mammalia, p. 68, 1840.
MYLODON. R. Owen, Description of the skeleton of an extinct gigantic sloth, *Mylodon robustus*, Owen, etc., p. 169, 1842.
ORYCTEROTHERIUM. R. Harlan, Amer. Jour. Sci. and Arts, ser. 1, vol. 44, p. 69, 1843.
PARAMYLODON. B. Brown, Bull. Amer. Mus. Nat. Hist., vol. 19, p. 569, 1903.
MYLODON. C. Stock, Science, n. s., vol. 39, pp. 761–763, 1914.
MYLODON. R. S. Lull, Amer. Jour. Sci. and Arts, ser. 4, vol. 39, p. 380, 1915.

SPECIES MYLODON HARLANI OWEN.

Megalonyx laqueatus Harlan. Medical and physical researches, p. 334, 1835.
Mylodon harlani Owen. The zoology of the voyage of H. M. S. *Beagle*, etc., part 1, Fossil mammalia, p. 68, 1840.
Orycterotherium missouriense Harlan. Amer. Jour. Sci. and Arts, ser. 1, vol. 44, p. 69, 1843.
Orycterotherium oregonensis Perkins. Amer. Jour. Sci. and Arts, ser. 1, vol. 44, p. 80, footnote.
Mylodon sodalis Cope. Bull. U. S. Geol. and Geog. Surv. Terr., vol. 4, p. 385, 1878.
Mylodon renidens Cope. Proc. Amer. Philos. Soc., vol. 34, p. 460, 1895.
Mylodon sulcidens Cope. Proc. Amer. Philos. Soc., vol. 34, p. 463, 1895.
Paramylodon nebrascensis Brown. Bull. Amer. Mus. Nat. Hist., vol. 29, p. 569, 1903.

DESCRIPTION OF MATERIAL.

DERMAL OSSICLES.

In the excavation of skeletal remains of *Mylodon harlani* at Rancho La Brea, numerous dermal ossicles (plate 21) were encountered, lying occasionally in a definite layer of asphalt that adhered to the larger bones. Professor J. C. Merriam (1906) directed attention to this occurrence, as follows:

"During the first examination of the beds several small, pebble-like bones were obtained which resembled the dermal ossicles of the ground-sloth, *Grypotherium*, recently described by Dr. A. Smith Woodward from skin

fragments obtained in a cave at Last Hope Inlet, Patagonia. The ossicles were in association with remains of a large ground-sloth somewhat similar to *Mylodon* in foot structure. Realizing that the peculiar conditions of accumulation offered an especially favorable opportunity for preservation of the dermal armor of a ground-sloth, during the second study of the deposits an attempt was made to find a specimen in which the armor might be recognized. Several hundred yards from the location of the first specimen, a large scapula resembling that of a mylodont was found partly exposed, with a row of small ossicles immediately over the outer side. The section of the bed containing these bones has recently been worked out, and the row of small bones proves to be the edge of a distinct layer including between 250 and 300 individuals. They mantle over the outer surface of the scapula, being removed from it by about an inch of asphalt.

"The layer of bones as we find it has probably been disturbed somewhat and does not occupy its original position exactly, but the fact that it remains as a distinct layer with a tendency toward similar orientation of the individual ossicles indicates that the disturbance has not been great. As the position of the layer in the asphalt was nearly vertical, the presence of the large number of ossicles together may not be attributed to the washing together of scattered elements on the floor of a small basin of deposition.

"The ossicles are not closely pressed together and are not superimposed. The individuals range in size from a cross-section of 6.5 x 4.5 mm. to 21 x 16 mm. Excepting a few of the largest ones, which are nearly square, the greater number are rounded and rather irregular in form. The outer side is in some cases more regularly modeled than the inner. The surface of the bones is somewhat roughened or pitted in some instances, but no markings are present which would be considered as definite sculpturing. The microscopic structure has not yet been examined.

"In general the form, size, and arrangement of the ossicles are much as in the bones in the *Grypotherium* skin from Patagonia. The skin fragment first described by Woodward was thought to represent mainly the region of the neck and shoulder. The Californian specimen mantles over the outer side of the scapula, and is presumably not far removed from its original position with relation to this bone."

In a statement concerning the ossicles from the asphalt, Dr. W. J. Sinclair (1910), after quoting the above from Professor Merriam, continues:

"Subsequent investigation has added little to this, so far as the localization of particular types of ossicles is concerned. Some idea of the diversity of forms assumed by them may be gathered from the accompanying figure, in which several of the types mentioned in the citation may be recognized (especially in fig. 1, *b*, *c*, *d*, *g*, and *h*), nor do these differ essentially from the great mass of scattered and unlocated ossicles. Pitted and smooth forms occur in the same individual. In some of the bones, except for minor undulations and the pores for the entrance of blood-vessels, the outer surfaces are smooth and polished (fig. 1, *e*, *f*). Others show a highly irregular pattern of small anastomosing ridges (fig. 1, *b*), but, as previously noted, there is no constancy or regularity in the pattern. Grooves cut across some of the ossicles, as shown in the figure. Some of these may be due to the fusion of two adjacent elements, as suggested by Woodward for the origin of a similar structure in *Grypotherium*."

FIG. 55.—*Mylodon harlani* Owen. Section through middle of a dermal ossicle showing entrance of a vascular canal and inner honeycombed cavity. × 2.0.

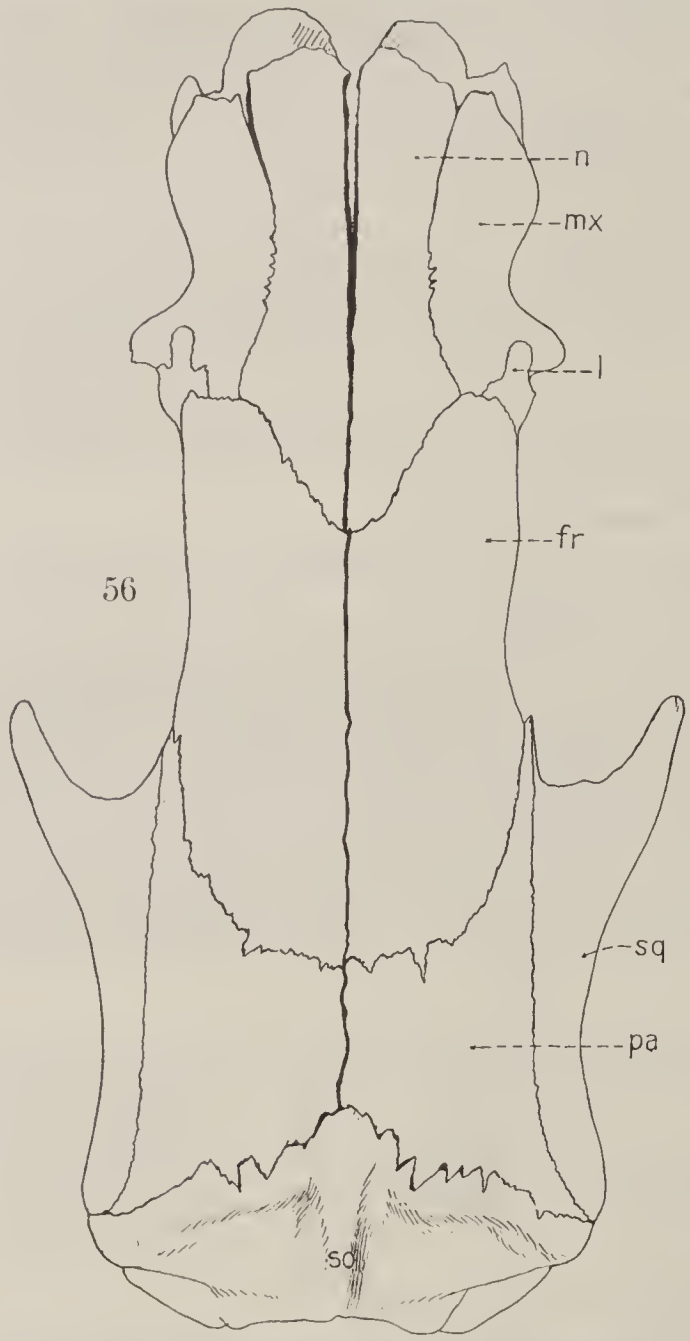
"Thin sections of the ossicles of *Paramylodon* were submitted to Professor E. G. Conklin, who has kindly examined them and furnished the following note:

" '*Histological character of dermal bone, horizontal and vertical sections.*—Penetrated by many canals for blood-vessels, which, in general, begin perpendicular to the surface, but soon branch repeatedly and frequently anastomose. Occasionally Haversian systems of lamellae and lacunae may be seen around these canals, but generally these lamellae and lacunae are very irregularly disposed between the canals. One of the most striking features is the presence of bundles of fibres which run in all directions through the bone, making the latter look almost like a woven fabric. These fibres are most abundant in the spaces between Haversian systems.' "

CRANIUM.

The greater number of skulls of *Mylodon harlani* from Rancho La Brea range approximately between 460 and 525 mm. in length (from the anterior end of the maxillary to the posterior end of the occipital condyles). None of the larger skulls reaches quite the length of the Colorado specimen described by Cockerell (1909). In several specimens the region behind the postorbital process is narrowed transversely, and an approach is made to the type of skull seen in *Mylodon garmani*. This compression above the braincase is, however, never so great in the material from the asphalt as in *M. garmani*. Contrasted with the skull of *Mylodon robustus*, that of *M. harlani* averages larger and is relatively more slender.

Viewed from above (plate 23), the skull is seen to be essentially similar to the specimen from Nebraska described by Brown (1903) and to that figured by Cockerell. The muzzle is somewhat inflated at the middle and narrows to a greater or less extent anteriorly. In *M. robustus* the muzzle widens from the region immediately in front of the malar process to the anterior end of the skull. The nasals are more or less constricted at the middle. Normally the fronto-nasal suture is V-shaped.



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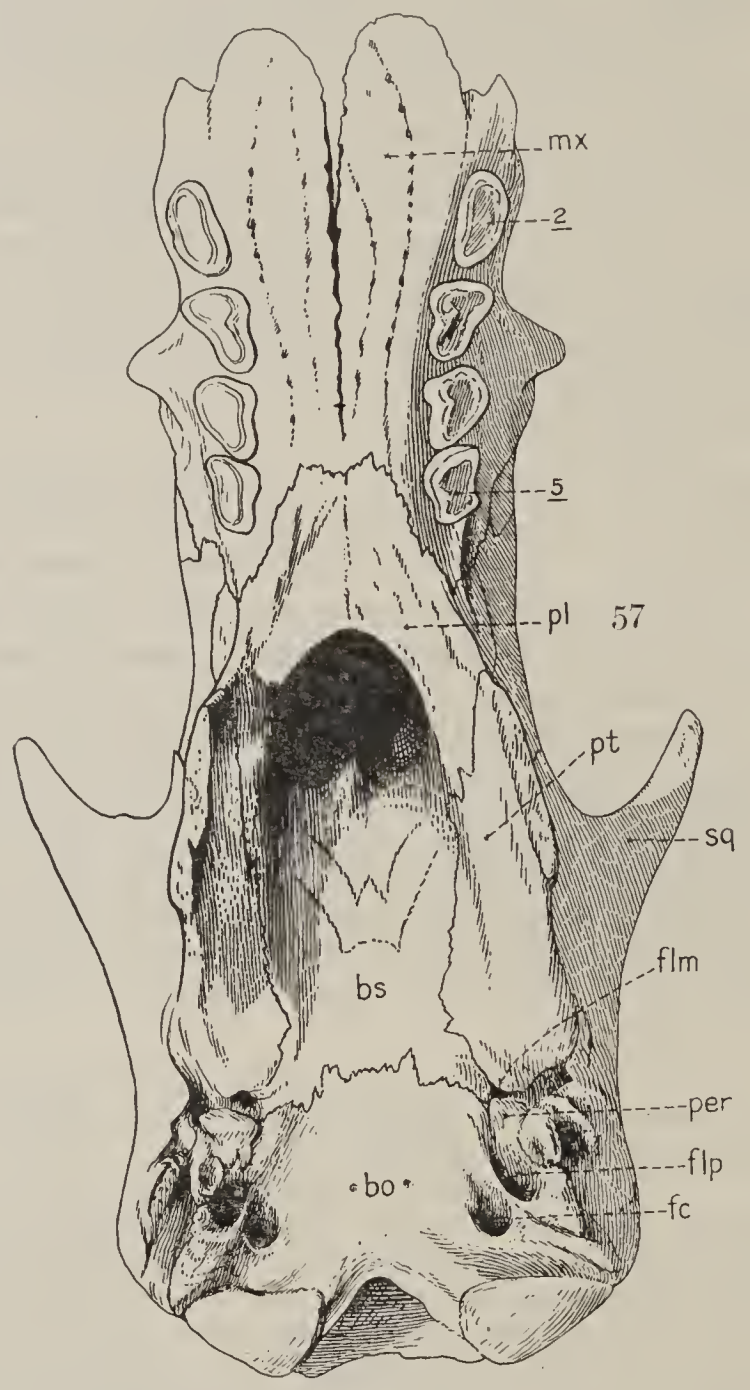

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Fig. 56.—*Mylodon harlani* Owen. Skull, dorsal view. × 0.33. *n*, nasal; *mx*, maxillary; *l*, lachrymal; *fr*, frontal; *sq*, squamosal; *pa*, parietal; *so*, supraoccipital. Rancho La Brea Pleistocene.

Fig. 57.—*Mylodon harlani* Owen. Skull, ventral view. × 0.33. *mx*, maxillary; *pl*, palatine; *pt*, pterygoid; *sq*, squamosal; *per*, periotic; *bo*, basioccipital; *bs*, basisphenoid; *flm*, foramen lacerum medium; *flp*, foramen lacerum posterius; *fc*, condylar foramen; 2, second superior tooth; 5, fifth superior tooth. Rancho La Brea Pleistocene.

The postorbital processes are not conspicuous. The supraorbital region does not widen backward so much as in *M. robustus*, and in some skulls it may narrow posteriorly. The flattened dorsal surface of the frontal and parietal, outlined laterally by the margins of the temporal muscles, varies in width, irrespective of the degree of slenderness of the skull. In slender skulls, for example, the width of the surface may be equal to or greater than that in some of the broader types. In skull 1717–19 the dorsal surface is very wide, thus resembling closely that in *M. robustus* as figured by Owen (1842, plate 3). In young individuals the lateral borders of the dorsal surface are not so distinctly defined.

The premaxillary (plate 23, fig. 2) is not firmly united with the maxillary in most skulls from the asphalt. A number of separate elements have been recovered from the deposit. They reflect in their size the broad type of skull possessed by *Mylodon harlani*, and resemble in their shape the corresponding bones of *M. robustus*. When paired they have a curious dart-like appearance and resemble the predentary structures in the dinosaurian genus *Triceratops*. The median arm is deep dorso-ventrally, and in transverse width tapers gradually to the posterior end. The lateral or diverging arm is comparatively thin, but is broad transversely. It is bent into undulating curves, and the posterior end, which may fuse with that portion of the maxillary lying in front of the tooth row, is often thickened. The anterior border of the pair forms a broad convex curve. In the skull of *Scelidotherium magnum* (Winge, plate 36, fig. 1), which is much narrower than that of *Mylodon*, the premaxillaries form anteriorly an acute angle and the arms are slender. Even in the narrow skull of *M. garmani* the premaxillaries still present an anterior convex border. At the posterior angle formed by the junction of the two arms a small canal is partially inclosed by bone. On the dorsal side a ridge may be developed anteriorly which swings from the posterior angle in a convex curve to the inner border, reaching forward about one-half the distance between the posterior angle and the anterior end. Here it meets a similar ridge developed on the opposite element.

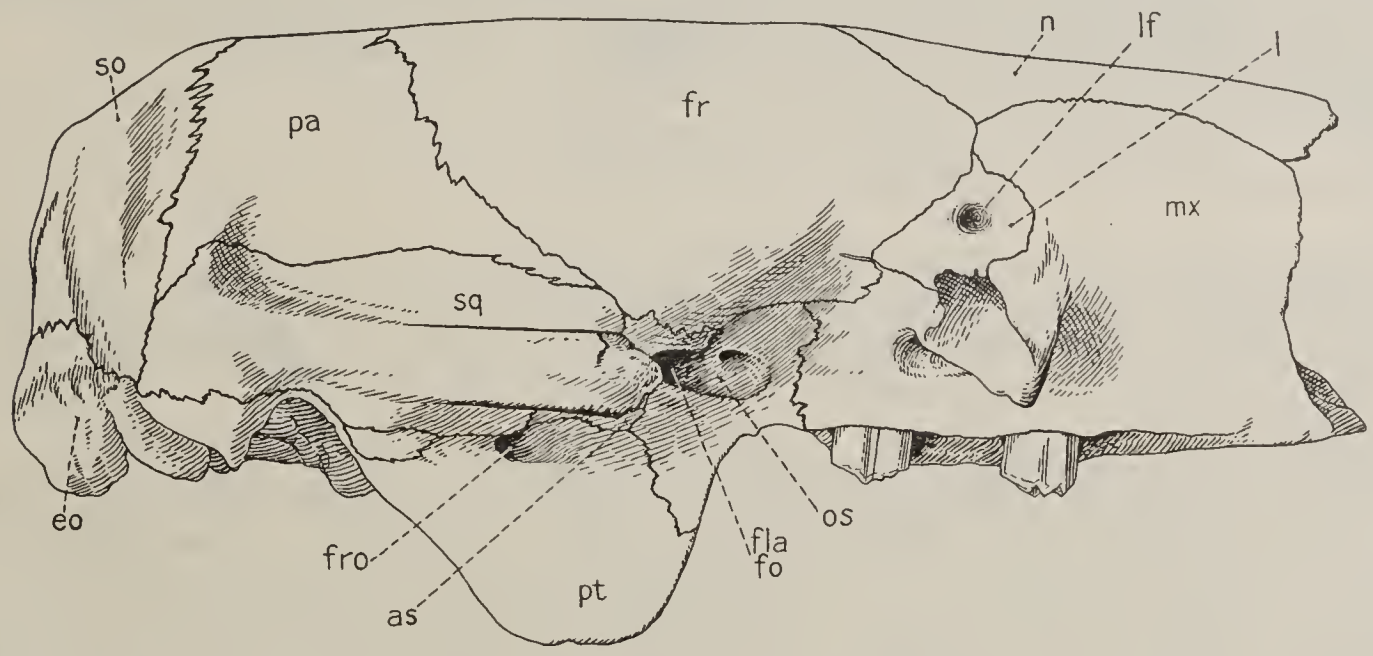


FIG. 58.—*Mylodon harlani* Owen. Skull, lateral view. × 0.33. *os*, orbitosphenoid; *as*, alisphenoid; *eo*, exoccipital; *lf*, lachrymal foramen; *fla*, *fo*, combined optic foramen and foramen lacerum anterius; *fro*, combined foramen rotundum and foramen ovale; remaining letters as in other figures. Rancho La Brea Pleistocene.

The combined width of the premaxillaries of *Mylodon harlani* is always greater than that in *M. garmani*, and the median arm is also distinctly longer in the Rancho La Brea species.

The average measurements (in millimeters) of 20 unpaired elements are as follows: Transverse width from medial face to end of diverging arm, 55.3; greatest length of median arm, 84.3; greatest length of diverging arm measured from antero-internal angle to end, 74.3.

The palate (plate 23, fig. 1) is noticeably convex antero-posteriorly opposite the third and fourth superior teeth. Anteriorly the palate may be either slightly or deeply concave along the median line. Between the last superior teeth and posterior to them the surface of the palatine is concave and slopes to the posterior nasal opening. The surface of the palate is perforated by a number of small foramina. The palatine posterior to the fifth superior teeth is very narrow transversely in the slender type of skull from Rancho La Brea. This character apparently does not depend on the slenderness of the cranium in the forms represented in the asphalt deposits. It should be noted also that in *M. garmani* the least width across the palatal portion of the palatine is actually greater

than in a broad skull of *M. harlani* (No. 21158 U. C. C.) of approximately the same length as that of the former.

The pterygoids are plate-like structures which may diverge slightly posteriorly. The inferior border is rounded. The base of the pterygoid at the inner posterior end forms a tuberosity. Between this and the wall of the pterygoid is the groove for the Eustachian canal, which widens in its forward extent. Between the pterygoid plates and on each side of the basicranial region may be seen frequently the two open channels that were traversed by the nerves making their exit through the anterior lacerate foramen and the combined foramina rotundum and ovale.

The base of the pterygoid is indicated along the inner side in some specimens by the suture line that extends back from the palatine and separates the element from the basisphenoid. The latter is the principal element in the basicranial region between the pterygoids. In front of the basisphenoid is the presphenoid, with the vomer probably also represented. A narrow process of the basisphenoid extends outward and backward and lies between the pterygoid and the basioccipital. Between this portion of the basisphenoid with the adjacent pterygoid and the periotic, lies the carotid foramen (*flm*). As seen in plate 23, the periotic and the structures immediately adjacent to it are comparable to those in *Mylodon robustus* and have been fully described by Owen (1842, p. 24). The tympanic is not always preserved, but when present it resembles that in other mylodont ground-sloths. Behind the large jugular foramen (*flp*) is the foramen for the twelfth nerve (*fc*). The condylar foramina are occasionally of unequal size in the same skull.

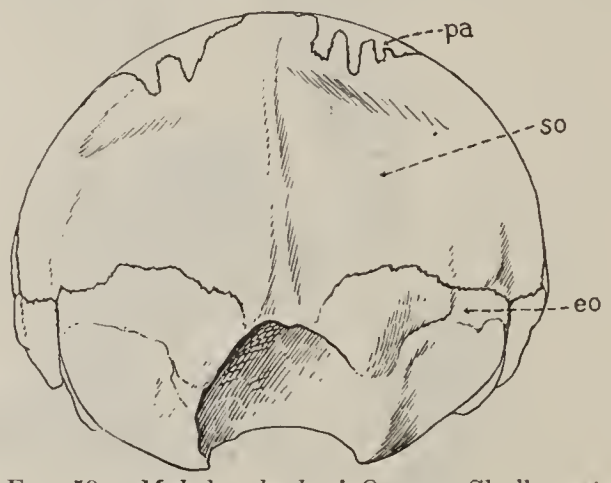


FIG. 59.—*Mylodon harlani* Owen. Skull, posterior view. × 0.33. Letters as in other figures. Rancho La Brea Pleistocene.

Auditory ossicles have been obtained from several of the skulls. The malleus and incus are available, but the stapes has not been recognized. Unfortunately, the manubrium is not preserved in the malleus (plate 23, fig. 3). The remainder of the specimen resembles that of the malleus of *Grypotherium* shown by A. Smith Woodward (1900, plate 6, fig. 4, *m*), but possesses only a single surface of union with the incus. The latter ossicle (plate 23, fig. 4) also resembles in shape that of *Grypotherium* (A. S. Woodward, 1900, plate 6, fig. 4, *i*). The diverging arms may be of nearly equal length, but in one specimen the arms are quite unequal.

The suture between basisphenoid and basioccipital extends between the anterior inner end of the periotic of each side. At each side of the anterior end the basioccipital is tuberous. Toward the margin of the foramen magnum the surface of the element flattens, and on each side of the median line at the middle it may be perforated by a vascular foramen. The ventral surface of the occipital condyles has the transverse diameter greater than the longitudinal, as in *M. garmani*, but in some skulls from the asphalt the surface may be quite wide longitudinally, as in the Colorado skull described by Cockerell.

In lateral view (plate 24) the dorsal surface is seen to be slightly depressed at the anterior end of the frontal. In this view it becomes apparent also that the occiput slopes downward at varying degrees. The lachrymal extends distinctly into the orbit and its foramen is conspicuous. The malar, which is generally found separate, has three forks or prongs. The upper and middle forks are usually of unequal length. The lower and middle forks are separated by a wide notch, as in *M. garmani*.

A rather large depression in the orbit is bounded above by the frontal, in back by the alisphenoid, and below by the orbital portion of the palatine. The orbitosphenoid is not clearly defined by suture. The optic nerve leaves the skull presumably through the anterior lacerate foramen (*fla*). Lying in front of the foramen is a rather large

opening through the palatine. At the anterior and lower end of the depression is situated the entrance to the canal that traverses the palate.

The channel through which the optic, first branch of the trigeminal, and other nerves reach the orbit exhibits further details. A small opening on the inner wall and a short distance behind the exit leads into a channel that has been traced back to between the third and fourth endoturbinals. A small channel, apparently for the fourth nerve, leaves the brain-chamber and extends forward a short distance and merges with the large one already described.

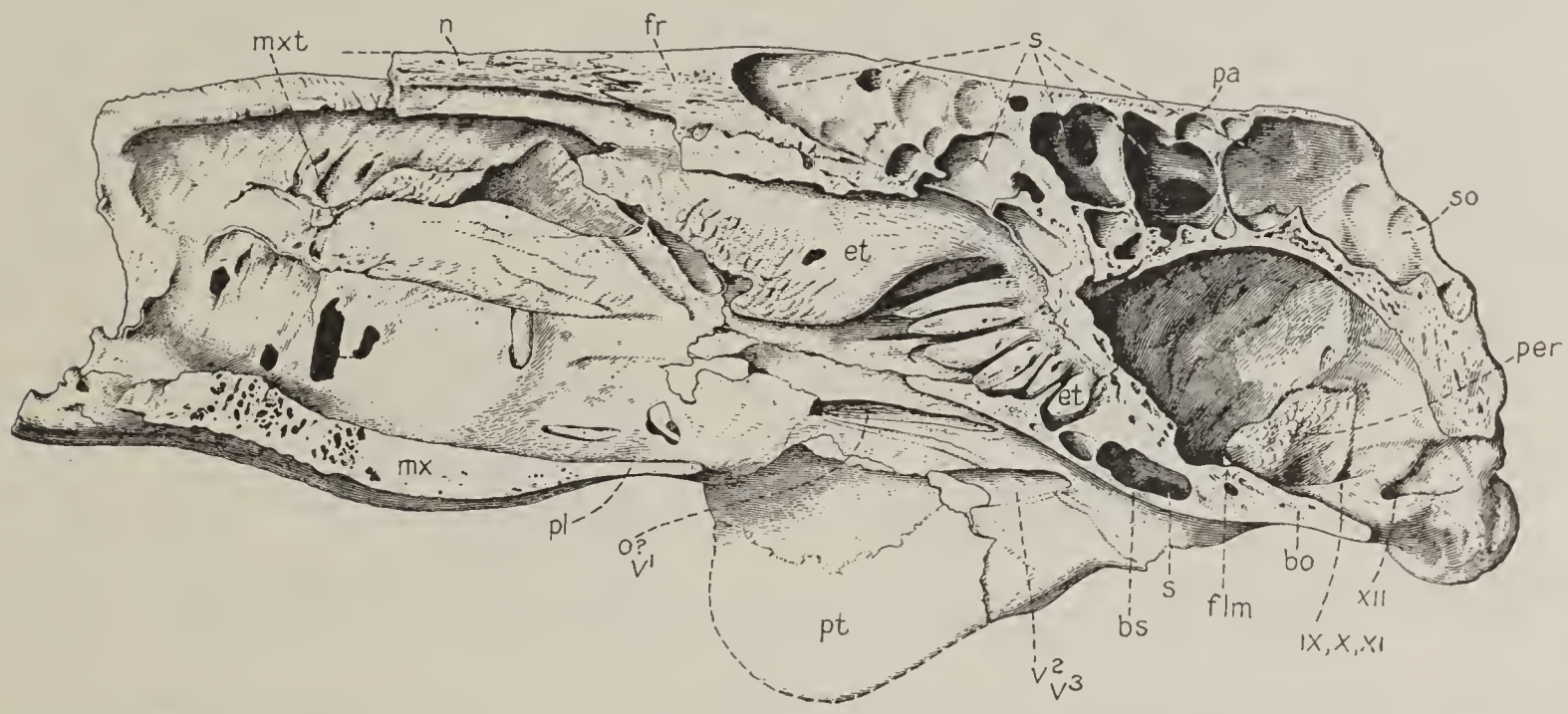


FIG. 60.—*Mylodon harlani* Owen. Vertical longitudinal section of skull, No. 1717-2. × 0.33. *mxt*, maxillo-turbinal; *et*, ethmo-turbinals; *s*, sinus in frontal, parietal, and basisphenoid; *o?V¹*, canal for first branch of trigeminal nerve and possibly the optic nerve; *V²*, *V³*, canal for second and third branches of the trigeminal nerve; *IX*, *X*, *XI*, exit for ninth, tenth, eleventh cranial nerves; *XII*, exit for twelfth nerve; remaining letters as in other figures. Rancho La Brea Pleistocene.

The exit (*fro*) for the remaining branches of the trigeminal nerve is situated below the front end of the base of the zygomatic process, where squamosal, alisphenoid, and pterygoid meet. This exit represents the combined foramina rotundum and ovale.

Skull 1717–2 has been bisected longitudinally. In viewing the internal structures (fig. 60), striking features are the relatively small size of the brain-chamber and the large number of air-cavities or sinuses (*s*) present in the bones that surround it. Anterior to the brain-chamber the vomer and mesethmoid have been removed and underlying parts come to view.

The maxilloturbinals are very much complicated in structure and occupy to a considerable extent the anterior portion of the nose on either side of the median septum. They are covered medially by a thin plate of bone, similar to that described in the

TABLE 61.

	No. of endo-turbinals.	No. of olfactory scrolls.	Remarks.
Mylodon harlani	7	8	Second from top endoturbinal divided.
Choloepus didactylus	7	7	
Tamandua tetradactylus	5	6	Second from top endoturbinal divided.
Myrmecophaga jubata	5	7	Second and fifth from top endoturbinals divided.
Dasypus villosus	6	8	Second and sixth from top endoturbinals divided.
Dasypus sexcinctus			
Xenvrus duodecimcinctus	8	9	Second endoturbinal divided.
Dasypus novemcinctus			

skull of *Choloepus didactylus* by Paulli,[a] and which is a forward continuation of the first endoturbinal of the ethmoid.

The ethmoturbinals also present a complicated form and indicate that the sensory epithelium of the nose was well developed in *Mylodon harlani*. We are principally in-

TABLE 62.—*Measurements (in millimeters) of skulls of Mylodon harlani.*

Catal. No. 1717, L. A. M. Coll.	Length from anterior margin of maxillaries to posterior end of occipital condyles.	Length of palate from anterior end of maxillaries to postpalatine notch.	Greatest width measured across ventral surface anterior to first teeth.	Width of palate measured between middle of inner sides of second superior teeth.	Width of palate measured between inner sides of anterior lobes of fifth superior teeth.	Least width posterior to fifth superior teeth.	Least distance from fifth superior tooth to middle of postpalatine notch.	Least distance across ventral margins of pterygoid plates.	Mastoid width above stylohyal processes.	Greatest width across occipital condyles.	Transverse diameter of foramen magnum.	Dorso-ventral diameter of foramen magnum.	Greatest width of muzzle.	Least width behind postorbital processes.	Height measured from plane of basioccipital to dorsal plane.
1	492.8	216.8	124.8	72.8	49	66.7	53.4	.....	184.9	127.8	43.5	36.9	130.9	107.5	139.5
2	497.9	217.5	151.6	79.6	49.3	68.3	50.1	120.6	191.5	131.2	40.4	39.5	147.6	114.2	123.6
3	466.2	212.5	.....	74	48.5	60.4	44.7	.....	188.8	133.9	47.6	40	124.1	115.6	143.5
4	493.7	221.8	131.1	66.9	54.4	71	[1]51	119.1	185.5	129.9	41.7	38.8	132.2	114.6	....
5	505.8	223	147	90.5	59.3	72.4	53.8	114	185.9	134.6	39.5	40	[1]146	105.3	138.5
6	520.6	226.3	142.4	77.6	55.3	68.5	41.3	122.4	[1]201.3	125.5	40	37.8	146.2	121.3	134.8
7	.....	.....	128.8	....	....	65.5	.....	.....	194.6	127.4	....	....	134.8	107.9	129.5
8	480.8	213.5	127.3	67	52	69.1	43	.....	186.3	133.3	43.9	42	128.6	115.3	142.2
9	516.5	.....	150.9	74.7	55.5	69.7	.....	.....	199.6	131.9	43.9	36.8	147.1	116.7	143.2
10	481.6	.....	135	74.5	58.9	69.1	.....	120.6	196.6	131.1	44	34.8	141.1	113	136.9
11	483.1	210.6	136.8	68.7	51.5	64.4	54	.....	188.2	134.5	42.5	36	[1]138	112.8	135.7
12	.....	.....	.....	....	....	....	.....	.....	.....	.....	....	....	.....	.....	....
13	[1]445.5	205.9	131.4	64.7	50.1	65.1	43.3	108.7	178.6	125.9	35.8	33.4	125.5	111.9	....
14	500.8	217	134.5	74.3	51.8	67.4	43.5	109.8	.....	136.4	46.4	38.5	135.8	116.1	....
15	519.6	[1]233.1	[1]149	79.1	62.5	77.3	[1]47.3	.....	.....	.....	51	36.2	147.2	.....	146.3
16	491.8	219.6	141.4	70.3	49.9	69.1	45.8	105	200.3	124.7	52.9	36.8	136.9	114.6	130.6
17	462.1	203.6	118.4	75.1	50.9	73.2	50.9	.....	179.6	131	45.3	38.2	127.1	112.5	142.3
18	502.9	.....	128.2	69.8	55.6	71.4	.....	.....	196.3	.....	42	36.3	131.3	111.2	129
19	492.2	.....	146.2	66	46.3	63.7	.....	.....	.....	133.2	44.6	32.9	.....	119.8	137.5
20	499.4	.....	.....	73.6	57.4	67.7	.....	.....	192.8	137.5	44.4	37.1	.....	120.2	148.2
21	.....	176.5	[1]116	85.4	42.2	57.8	36.8	87	158.3	[1]131.5	41.7	33.6	[1]122	96.8	123
22	492.6	218.4	141	76.7	45.6	64.2	43.5	.....	188.5	132.1	50.8	42	137.3	120.6	136.1
23	461.8	199.8	139.8	69	45.2	63.3	42.2	106.4	182.5	.....	48.4	37.6	132.6	113.3	138.6
24	507.8	.....	139.5	78.6	58	....	.....	.....	191.6	135.6	49.5	36.2	[1]145.5	112.3	137.9
25	.....	.....	.....	78.2	57.9	....	.....	.....	.....	136.9	43	40.8	[1]139.5	.....	152.6
26	[1]424.5	183.3	[1]115.5	61.8	41.7	59.4	[1]43	.....	162.8	[1]129	41.3	38.7	117.9	[1]94.5	119.7
27	499.7	223.9	145.5	78.8	53.7	[1]66.2	53.9	.....	193.8	.....	43.5	37.8	142.8	[1]108	....
28	.....	.....	135	65.8	42.6	60.7	.....	.....	.....	.....	....	....	135.7	106.5	....
29	.....	.....	132.8	77.5	51.5	....	.....	.....	.....	.....	....	....	131.8	96.4	....
30	.....	.....	.....	[1]61.9	[1]43.5	....	.....	.....	.....	.....	....	....	.....	106.4	....
31	.....	.....	.....	....	....	....	.....	.....	179.3	120.9	43.5	33.5	.....	.....	140.1
32	527.6	237.8	151.3	....	....	72.4	56.6	.....	198.2	138.7	....	....	143.8	120.7	141.6
No. 21170 U.C.C.	513	237	156	....	....	72.2	55.8	124.4	210	143.3	....	....	157	134	157
No. 21158 U.C.C.	498	222	135.4	....	....	69.9	54.3	113.9	196	120	....	....	137	113.7	135
No. 21156 U.C.C.	512	218	138.8	....	....	61.4	46.5	118	193	143.9	....	....	134	106.6	151

[1] Approximate.

debted to Paulli for a very complete comparative study of the structure of the mammalian ethmoid, and it is interesting to compare the structures found in the Pleistocene form from Rancho La Brea with those noted by Paulli in Recent edentates. Seven endoturbinals are present in *M. harlani*, a number corresponding to that in *Choloepus*

[a] S. Paulli Über die Pneumaticität des Schädels bei den Säugethieren. Morphol. Jahrb., vol. 28, pp. 147–251, 483–564, plates 7, 8–14, 27–29, 1899–1900.

didactylus. The first endoturbinal in the Rancho La Brea genus forms a relatively large scroll. A forward continuation of this endoturbinal forms a cover to the maxilloturbinal, as already mentioned. The second endoturbinal, in contrast to that of *Choloepus*, gives rise to two scrolls, of which the ventral one is the larger.

The endoturbinals of *M. harlani* are given in table 61 with those of recent edentates recorded by Paulli.

It is seen from table 61 that *Mylodon*, in agreement with other American edentates, possesses a number of endoturbinals in excess of that usually found in mammals (5). The number of endoturbinals in this Pleistocene ground-sloth is duplicated only in *Choloepus* among the forms investigated by Paulli.

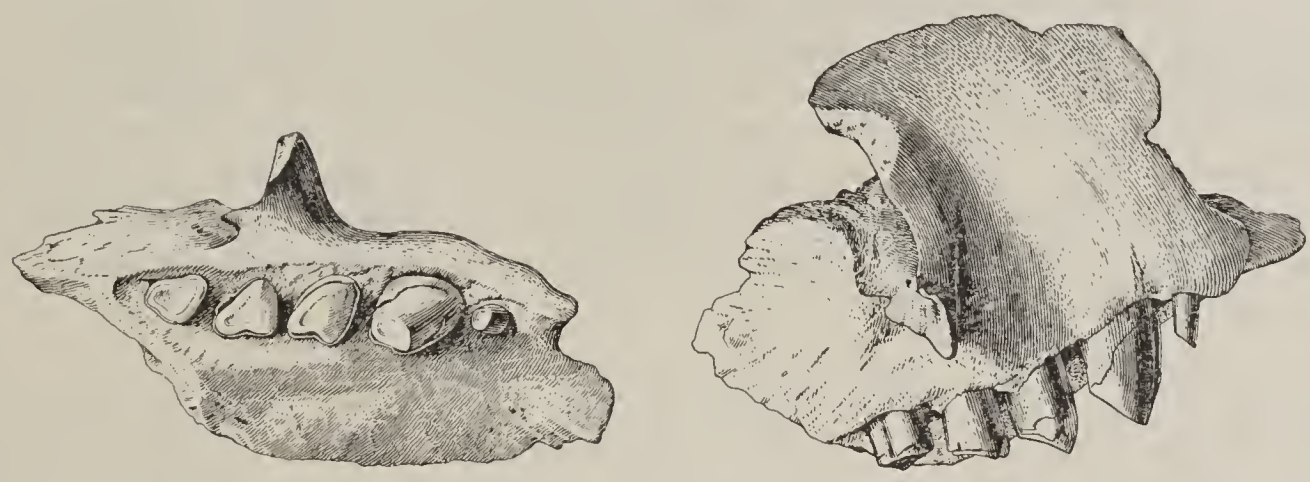


FIG. 61.—*Mylodon harlani* Owen. Skull-fragment with right superior teeth of young individual, No. 1717-35; inferior and lateral views. × 0.50. Note small size of first superior tooth. Rancho La Brea Pleistocene.

MANDIBLE.

In the mandible (plate 24 and plate 27, fig. 1) of *Mylodon harlani* the horizontal ramus is thick. In many specimens from Rancho La Brea the ramus decreases distinctly in depth from the base of the coronoid process to the anterior side of the first lower tooth, in which character they closely resemble the material from Nebraska described by Brown. In other mandibles, as, for example in No. 1717–10 L. A. M., and in No. 21576 U. C. C., this decrease in depth is not so noticeable and the specimens resemble more the type of lower jaw in *M. garmani* and in *M. robustus*. The predental region possesses usually concave lateral borders, so that the width across the anterior end of the mandible is slightly greater than that across the middle. In some the lateral border may be fairly straight. The width across the front end is always less than the distance across the front teeth measured from their outer surfaces. The anterior upper end of the predental region may extend distinctly above the upper surface of the ramus just in front of the first tooth.

The symphyseal keel varies somewhat in size and in outline when viewed from the side. The anterior margin of the keel slopes gently downward and backward from the anterior border of the mandible. Below a level with the lower end of the anterior mental foramen the anterior margin curves more decidedly backward and then turns downward again toward the ventral border. Usually two mental foramina are present, and of these the lower anterior one is the larger. The bridge of bone separating the two foramina may be narrow or wide. Often additional foramina are present in this region, but the total number usually does not exceed three. Sometimes three foramina are present in one ramus and two in the opposite ramus.

The postero-external opening of the dental canal is situated just below the front end of the base of the coronoid process or opposite the posterior lobe of the last lower tooth. Occasionally it varies slightly in position. The coronoid process is broad and rather erect. It is sometimes narrow. When erect, the sigmoid notch may open widely.

In some specimens the end of the process extends backward to a point vertically above the anterior portion of the condyle and the sigmoid notch is fairly narrow. The condyle projects inwardly and has a rugose surface. The obliquity of the long axis of the condyle with reference to the fore-and-aft direction of the ramus varies somewhat. The angle may be broad, or it may be relatively narrow. The angle may resemble that in the mandible of *M. garmani.* In some specimens it is acute. The postero-internal opening of the dental canal always appears to be larger than that of *M. robustus.*

DENTITION.

Dental formula: $\frac{5-4}{4}, \frac{5-4}{4}$.

In the possession of lobate teeth the mylodont ground-sloths exhibit considerable difference from other gravigrade edentates in which the teeth have a simpler form. The individual teeth in *Mylodon harlani,* as in other mylodont ground-sloths, consist of a relatively soft inner material, the vascular dentine of Owen, surrounded by a harder layer of dentine. The external surface of the hard layer is marked by transverse undulating lines. Covering this surface is a thin layer of cement, with external surface showing longitudinal lines. In Rancho La Brea specimens the outer layer peels away readily from the hard dentine.

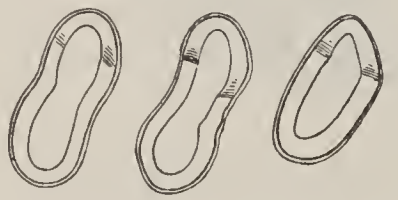


FIG. 62.—*Mylodon harlani* Owen. Occlusal views of second superior tooth, showing variation in shape of crowns. × 0.50. Rancho La Brea Pleistocene.

FIG. 63.—*Mylodon harlani* Owen. Occlusal views of left fourth superior tooth, showing variation in shape of crowns. × 0.50. Rancho La Brea Pleistocene.

FIG. 64.—*Mylodon harlani* Owen. Occlusal views of right fifth superior tooth, showing variation in shape of crowns. × 0.50. Rancho La Brea Pleistocene.

The superior tooth-rows in most specimens from Rancho La Brea do not diverge anteriorly as much as in *Mylodon robustus.* In No. 21159 U. C. C. the divergence of the tooth-rows approximates closely that in a skull of *M. robustus* considered by Lydekker (1894, p. 79, plate 49, fig. 2) as belonging to a female.

Thirty-one skulls in the Los Angeles Museum and 19 in the Museum of Paleontology, University of California, furnish the following data on the presence and absence of the first tooth in the superior dentition:

First superior tooth present on right and left sides	21
First superior tooth absent on right and left sides	14
First superior tooth present on right side and absent on left side	5
First superior tooth present on left side and absent on right side	7
Doubtful	3
	50

It should be noted in this connection that when the first tooth is present it is not always of normal size. This is well shown, for example, in No. 21158 U. C. C., a skull of average size, in which the alveolus for the first tooth measures approximately 8.5 by 8.2 mm.

The series of specimens from the asphalt demonstrates that the tooth may have actually disappeared during the life of the individual. In skull 1717–9 the alveolus for the first tooth of the left side was originally as large as that of the right side. Around the border, however, a growth of bone has taken place which shows a tendency to reach toward the middle of the tooth-socket. That this actually takes place is clearly seen in 1716–1, in which the closing of the first superior alveolus has progressed much further. In this skull the left alveolus is almost completely closed, while that of the right side has a shallow, crescentic opening along the lingual border.

No. 1717–12 illustrates how the entire alveolus may be filled by a growth of bone. The final stage is reached in No. 21156 U. C. C. or in the Nebraska skull described by Brown (1903), where the first tooth has disappeared entirely, its former presence being indicated by a scar in front of the second superior tooth. Burmeister (1886, p. 1132) directed attention to a similar closing of the first superior alveolus in the South American *Grypotherium*.

TABLE 63.—*Measurements (in millimeters) of mandibles of Mylodon harlani.*

Catalogue No. 1718.	Length from anterior end of symphysis to posterior end of condyle.	Greatest length of symphysis.	Greatest predental width.	Depth of ramus between third and fourth inferior teeth, measured normal to inferior margin.	Catalogue No. 1718.	Length from anterior end of symphysis to posterior end of condyle.	Greatest length of symphysis.	Greatest predental width.	Depth of ramus between third and fourth inferior teeth, measured normal to inferior margin.
1	359.5	113.7	143.5	93.5	21	381.1	96.2	135.3	83.2
2	409.8	108.9	[1]154	95.6	22	382.1	101.5	128.7	83.2
3	.....	97.8	123.6	80.4	23	355.4	94.6	122.2	83.5
L5	363.8	96.9	126.6	79.4	24	[1]382	.....	145.1	92.1
L6	386.8	.....	.....	[1]93.3	25	372.6	90.9	128.2	85.1
L7	[1]330	.....	.....	73.3	26	377.1	108.2	137.4	79.7
L8	.....	.....	.....	73.8	27	383.6	100.6	142.3	85
L9	374.1	.....	.....	87.9	28	388.5	97.8	142.1	88
L10	387.8	.....	.....	97.1	29	386.9	113.5	[1]151	96
L11	[1]295.5	.....	.....	69	30	382.5	92.1	130.1	83.8
R12	.....	.....	.....	87.8	31	.....	.....	.....	91.9
R13	375.1	.....	.....	.....	32	394.4	111.4	145.4	84.6
R14	353.1	.....	.....	78.3	33	367.3	96.9	130.3	77.3
R15	379.1	.....	.....	85.2	No. 21170				
R16	385.4	.....	.....	94.6	U. C. C.	386	115.6	[1]109.5	92
17	[1]375	93	124.9	79	No. 21158				
18	.....	99.6	144.1	[1]95	U. C. C.	386	116.4	[1]95.9	83
19	.....	.....	130.9	85	No. 21156				
20	393.1	104.6	141.8	88.5	U. C. C.	385	109.5	102.7	94.7

[1] Approximate. L, left ramus; R, right ramus.

The crown of the first superior tooth ($\underline{1}$) is distinctly curved and is round or oval in cross-section. The surface occluding with the first inferior tooth is worn obliquely to the crown. The layer of hard dentine is relatively thicker in this tooth than in other superior teeth. The second superior tooth ($\underline{2}$) has the greatest antero-posterior diameter of any of the upper teeth. The tooth varies somewhat in the long diameter (see fig. 62), but seems never to be shortened in this direction so much as in *Mylodon robustus*. The sides of the tooth may be flat or slightly convex. In some specimens a median longitudinal sulcus extends the length of the crown on the inner and outer sides. The occlusal surface is beveled anteriorly and posteriorly, the former surface wearing against $\overline{1}$, the latter against the anterior half of the occlusal surface of $\overline{2}$.

The third superior tooth ($\underline{3}$) remains quite constant in shape and resembles closely the corresponding tooth in *M. garmani*. The description which Allen (1913, p. 324) gives of the tooth can be applied also to $\underline{3}$ in the specimens from Rancho La Brea. The antero-internal lobe of the tooth occludes with $\overline{2}$, while the postero-internal lobe and the antero-external lobe wear against $\overline{3}$.

The fourth superior tooth ($\underline{4}$) may resemble somewhat $\underline{3}$ in shape, but as Allen has indicated, the former tooth is more compressed in the long axis of the tooth-row. A review of the series from the asphalt reveals some variation in the shape of $\underline{4}$ as shown in figure 63. Occasionally, $\underline{4}$ may be so compressed as to resemble closely the tooth in *M. garmani;* $\underline{4}$ occludes with the anterior lobe of $\overline{4}$.

TABLE 64.—*Measurements (in millimeters) of the dentition of Mylodon harlani.*

Superior teeth.											Inferior teeth.										
Catal. No. 1717, L. A. M. Coll.	Length of superior tooth series, alveolar measurement.	1, antero-posterior diameter.	1, transverse diameter.	2, antero-posterior diameter.	2, transverse diameter.	3, antero-posterior diameter.	3, transverse diameter.	4, antero-posterior diameter.	4, transverse diameter.	5, antero-posterior diameter.	5, transverse diameter.	Catal. No. 1718, L. A. M. Coll.	Length of inferior tooth series, alveolar measurement.	$\bar{1}$, antero-posterior diameter.	$\bar{1}$, transverse diameter.	$\bar{2}$, antero-posterior diameter.	$\bar{2}$, transverse diameter.	$\bar{3}$, greatest diameter across occlusal surface.	$\bar{3}$, diameter of occlusal surface normal to greatest diameter.	$\bar{4}$, antero-posterior diameter.	$\bar{4}$, greatest diameter of anterior lobe.	$\bar{4}$, greatest diameter of posterior lobe.
[4]1	119.8	....	....	[1]31.8	[1]19.9	28.1	23	....	....	25.4	22.4	1	135.5	24.2	17.5	[1]31	[1]26	[1]32	20.5	56	27.3	21.8
[2]2	141.9	15.2	13.9	32.5	19	23.2	23.8	23.1	25.1	23	19.3	2	151.4	25	17.6	29.9	26.5	32.7	20.1	59.9	25.6	21.8
[4]3	.....	....	....	33	[1]17	....	....	....	....	....	....	3	.....	13.2	15.4	25.8	21.4	30.2	17.8	52.1	....	....
[3]4	111.3	....	....	....	....	....	....	....	....	22.5	16.6	5	.....	....	....	27.9	22.6	31	[1]17	49.3	[1]20	[1]20
[3]5	142.8	16.7	15.4	33.7	17.1	32.1	21.9	27.8	23.4	25.6	19.9	6	.....	[1]19	13.7	28.3	[1]22.8	....	....	....	....	....
[4]6	136.1	....	....	36.3	17.7	30.9	[1]25	25.5	27.8	24.7	[1]21	7	.....	....	....	....	....	....	....	48.7	21.5	18.3
[3]7	138.2	14.9	13.2	29.5	15.9	27.8	23.7	20.8	22.9	....	....	8	131.1	20	13.5	28.3	22.1	....	....	51.6	23.4	[1]19
[2]8	.....	....	....	31.5	14.8	27.6	21.8	21.9	22.8	....	....	9	.....	....	....	....	....	....	....	44.4	[1]21.5	[1]19
[2]9	.....	....	....	....	....	....	....	....	....	24.3	19.9	10	.....	....	....	....	....	....	....	[1]52	....	....
[3]10	137.8	17	13.6	30	16.9	27.3	24.4	22.5	25.1	24.9	[1]20	11	.....	....	....	....	....	....	....	45.6	....	....
[4]11	114.8	....	....	31	16	26.9	22.7	20.4	23.9	23.2	19.3	12	.....	....	....	....	....	....	....	51.6	22.3	19.5
[2]13	.....	....	....	....	....	....	....	....	....	[1]27.7	....	13	.....	....	....	31.3	23.1	....	....	....	....	....
[4]15	129.3	....	....	39.5	[1]16.5	26.7	22.4	20.9	24.6	30.4	[1]19.1	14	128.4	20	12.5	24	19.9	24.6	16.8	50	[1]22.5	19.4
[4]17	.....	....	....	34.3	16.5	....	....	[1]19	22.2	[1]22	18	15	139.1	23.7	16.3	28.5	23	31	19	51.9	[1]25	[1]21
[4]18	127.1	....	....	34.9	17.9	26.4	[1]22.3	26.4	19.1	24.4	19.4	18	138.2	23.6	[1]15.5	....	....	....	[1]18	58.6	23.1	....
[2]19	155.5	22	[1]21	41.2	[1]17	27.3	21.1	[1]22.2	....	25.9	19	19	.....	....	....	....	....	28.2	16.9	....	....	....
20	118.9	....	....	30.9	17.3	[1]26.5	[1]26	....	....	22.2	18.2	20	126.7	19.2	14.9	25.3	19.2	25.8	14.5	45.9	18.9	16.1
[3]22	153.1	16	13.5	31.7	20.4	30.2	24.6	24.6	24.8	20.9	16.5	21	135.3	22.5	15.6	....	....	27.5	16.4	49.4	23.7	20
[3]23	117.4	....	....	33	16.2	25.5	22.6	24.1	19.5	23.8	16.9	22	.....	....	....	....	....	....	....	49.4	[1]22	17.5
[4]24	122.8	....	....	33.2	17.9	25.2	22.1	[1]20	23.8	26.4	18.4	23	.....	....	....	[1]29	[1]22	....	....	....	[1]23	....
[2]25	.....	....	....	[1]32.9	[1]18	....	....	....	....	[1]24.5	....	24	.....	....	....	....	....	29.8	19.3	53.5	24.5	20.6
[4]26	.....	....	....	....	....	22.2	17.8	20.1	20.5	....	....	25	130.9	22	17.5	....	....	[1]25.1	....	51.4	23.7	21.2
[3]29	117.8	....	....	31.5	16.1	27.5	[1]22.5	22	23.3	24	18.4	27	139.1	20.7	13.9	27.3	21	27.6	....	50.7	21.9	19.4
[2]32	149.1	20.7	17.1	32.4	18.8	28.2	26.1	23.9	28.1	24.4	22.3	28	138.3	21.9	16.8	[1]31	[1]23.6	....	....	54.2	[1]26	23.1
No. 21170												29	.....	....	....	29.2	23.1	....	....	51.8	25	21.8
												30	143.4	20	17	....	....	....	....	[1]55	[1]25	[1]22
U. C. C. No. 21158	153	20.5	20	28.8	20.7	26.4	26	22.7	27.7	24.8	22.8	31	142.9	22.4	16.1	28.5	....	28.6	17.4	53.4	22	19.5
												32	146	23.9	18.9	29.5	23.8	....	....	53.2	24.8	21.2
												33	137.4	16.5	13.1	27.3	20.4	28.2	17.3	55.5	21.8	20.5
U. C. C No. 21157	136.2	....	....	30.9	15.4	26.2	22	....	....	....	....	No. 21170										
U. C. C.	126.3	....	....	41.3	17.7	26.3	21.3	22.4	24.7	[1]20.2	[1]20	U.C.C. No. 21158	145.3	23.7	20.2	28.4	23.4	33.8	[1]20	[1]50.4	[1]29	23.7
												U.C.C. No. 21156	141.5	....	...	26.6	20.8	27.4	17.4	.....	.....	.....
												U.C.C.	149.5	26.1	18.2	....	....	26.3	[1]23	56.7	32.3	24

[1] Approximate. [2] First superior tooth present on both sides. [3] First superior tooth present on one side only. [4] First superior tooth absent on both sides.

In $\underline{5}$ (fig. 64) the anterior lobe is always more expanded than the posterior lobe. Usually the sulcus on the outer side of the tooth is shallow, but in some specimens the groove may deepen; $\underline{5}$ occludes with the posterior portion of $\overline{4}$.

The form of the triturating surface of the first inferior tooth ($\overline{1}$) is dependent upon the presence or absence of the first superior tooth. When the latter is present, the wearing surface of $\overline{1}$ consists of an anterior and a posterior beveled face meeting in a transverse ridge across the middle of the crown. When the first superior tooth is absent a single wearing surface occurs in $\overline{1}$ and is directed to the inner posterior side. This type of tooth resembles that in Brown's specimen from the Pleistocene of Nebraska. In passing, it should be noted that $\overline{1}$ in the Nebraska ramus has moved from the normal position in the alveolus.

FIG. 65.—*Mylodon harlani* Owen. Occlusal views of left third inferior tooth, showing variation in shape of crowns. × 0.50. Rancho La Brea Pleistocene

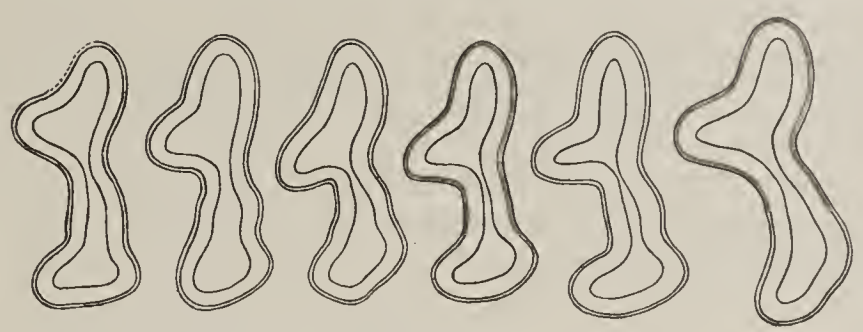


FIG. 66.—*Mylodon harlani* Owen. Occlusal views of right fourth inferior tooth, showing variation in shape of crowns. × 0.50. Rancho La Brea Pleistocene.

$\overline{2}$ is not unlike the tooth in *M. garmani*. A deep longitudinal sulcus extends the length of the inner face at approximately the middle and assists in defining the antero-internal and postero-internal lobes. A shallow and broad sulcus situated on the outer posterior side defines also an antero-external lobe.

The third inferior tooth ($\overline{3}$) may occasionally be quite broad from the antero-internal to the postero-external side (fig. 65). Teeth from the asphalt may resemble closely in shape $\overline{3}$ of the types of *M. harlani* and *M. garmani*.

TABLE 65.—*Measurements (in millimeters) of endocranial cast of Mylodon harlani, skull No. 1717–33.*

Greatest length from anterior end of cerebrum to posterior end of cerebellum	[1]117
Greatest transverse diameter of anterior end of cerebrum	81
Greatest transverse diameter of posterior end of cerebrum	[1]96
Transverse diameter of cerebellum	[1]90.4
Height from infundibulum to dorsal surface of cerebrum	75

[1] Approximate.

As shown in figure 66, the shape of the fourth inferior tooth ($\overline{4}$) varies considerably. The anterior lobe is always more or less oblique to the long axis of the tooth-row, while the posterior lobe may sometimes be at right angles to it. The external surface of the isthmus connecting the two lobes may form a convex ridge extending longitudinally, giving the tooth an appearance similar to that in Brown's specimen of *Mylodon* from Nebraska.

ENDOCRANIAL CAST.

The dorsal, lateral, and ventral views of the endocranial cast of *Mylodon harlani* are shown in plate 26. A greater difference in width between the anterior and posterior portions of the cerebrum in *Mylodon harlani* is seen when a comparison is made of the dorsal views of the endocranial casts of the North American genus and of *Grypotherium* (Woodward, 1900, plate 7). In lateral view the cerebral part of the cast is seen to descend more gradually to the olfactory lobes than in *Grypotherium*. Judging from the surface of the cast, the cerebrum was rather richly convoluted. The cerebellum is relatively less prominent in *M. harlani* than in *Grypotherium*. It is decidedly smaller than in *Glyptodon*. In the form from Rancho La Brea the olfactory lobes extend noticeably in front of the cerebrum and are divergent when viewed from above.

ELEMENTS OF HYOID ARCH.

The elements of the hyoid apparatus (plate 27, fig. 2) in *Mylodon harlani* resemble closely in their general features those of *M. garmani,* which have been adequately described by Allen (1913, p. 327, pl. 3, figs. 5, 6), as follows:

"The stylohyal is the longest, 130 mm. in extreme length, with an irregularly rounded stem, expanding dorsally into a squarish plate at whose anteroventral corner is a rounded projection for articulation with the skull. Distally it bears a transverse articular surface. What corresponds to an epihyal articulates by a flat surface with the ventral end of this bone. It is compressed laterally and its distal portion is transversely expanded with an elliptical articular facet, 14 × 10 mm., on its posterior face. Its extreme length is 62 mm., or about half that of the stylohyal. A third smaller bone of trapezoidal outline, with a small elliptical facet on each of its convergent sides, serves for the articulation of the epihyal with the body of the hyoid. This series of three bones is present on both sides, and the two smallest, or ceratohyals, articulate each with the facet of a protuberance marking either end of the body or basihyal. The last is thoroughly ankylosed with the thyrohyals to form a V-shaped bone, whose sides are a little expanded dorsally and whose point is widely emarginate at its posterior border. A small facet at the posterior tip of each cornu probably marks the attachment of cartilage."

Specimens of the stylohyal from Rancho La Brea average 129.3 mm. in extreme length (shortest, 117.7 mm.; longest, 139.4 mm.), and thus approximate closely the corresponding element of *M. garmani.* The medial surface of the proximal expanded portion is often formed into several concavities separated by low ridges. The lateral surface, on the other hand, is comparatively smooth and even with exception of that portion near the dorsal border where rugosities are developed which aid in the attachment of the stylohyal to the skull. The epihyal of *M. harlani* is somewhat longer than that of *M. garmani;* specimens from the asphalt beds average 70.8 mm. in total length (shortest, 63 mm.; longest 79.1 mm.). A single example of fusion of stylohyal and epihyal has been noted in the museum collections.

The chain of elements constituting the hyoid apparatus in *M. harlani* resembles that of the South American form figured by Burmeister.[a]

On the posterior side and at the end of each cornu of the basihyal a small facet is present, as already noted by Allen. These facets indicate points of contact with the thyroid cartilage. In the collections of the Los Angeles Museum occur specimens, indicative of at least four individuals of *Mylodon harlani,* in which the thyroid cartilage is ossified. The element thus formed, when viewed in posterior aspect, has somewhat the appearance of a large avian wishbone. Unfortunately, all the specimens from the asphalt beds are more or less fragmentary, and this condition is to be attributed alike perhaps to their somewhat delicate structure and to the incomplete ossification of the cartilage. Among the living South American edentates, an ossification of the thyroid cartilage is known to occur in the giant ant-eater (*Myrmecophaga jubata*). It has not been determined whether in *Mylodon harlani* the ossification of the cartilage is a constant characteristic of the animal or whether such ossification occurred only in old individuals. The fact that only four individuals are certainly known to possess an ossified thyroid may suggest the latter, but the chances of preservation in a sufficiently complete state to permit recognition may likewise be a potent factor in accounting for the shortage in the representation of this element. It is entirely probable that a number of additional specimens will become available when the entire Rancho La Brea collection of vertebrate material is examined in detail. It is also to be noted that, in the small series at hand, considerable variation is shown in the size of the specimens, and that the slender element, No. 1705–3, does not represent an old individual.

The thyroid ossification is broad in antero-posterior extent, with the ventral surface sharply keeled in median line and toward the anterior end. Posteriorly the keel ends in a gentle and broad convexity which on the dorsal surface is expressed by a concavity

[a] H. Burmeister. Lista de los mamiferos fosiles del terreno diluviano. Ann. Mus. Buenos Aires, vol. 1, plate 5, fig. 9, 1864–1869.

lying adjacent to the posterior border and at the median junction of the sides of the thyroid. This concavity is divided by a low median ridge which supports a tubercle. The dorsal or free extremities of the sides of the element are modified to secure attachment with adjacent structures. At the antero-dorsal angle of the side a process is formed which bears an elliptical facet directed forward and outward and which secures the attachment of the thyroid with the lateral arms of the basihyal. Between the anterior and posterior processes the wall of the thyroid, in specimen No. 1705–2, is pierced by a short canal which extends from the dorsal surface to the inner side. This foramen is absent in the second specimen (No. 1705–4), in which this region of the thyroid is preserved.

The posterior process is much more prominent than the anterior; it may be quite thick at the base, and the external surface is strongly ridged and bears at the tip an obliquely placed, elongated elliptical facet which is directed mainly inward and slightly upward. This facet joined with the cricoid element. From the nature of the surface of this facet, which, in contrast to that of the anterior facet articulating with the cornu of the basihyal, is not smooth, but roughened, seems to indicate that the cricoid cartilage was not ossified.

TABLE 66.—*Measurements (in millimeters).*

Stylohyal:		
Greatest length, average 20 specimens, right series	129.3	
Width of proximal end, average 21 specimens, right series	47.6	
Epihyal:		
Greatest length, average 25 specimens, right series	70.8	
Greatest width, average 24 specimens, right series	32.6	
Ceratohyal; left series:		
Greatest length	30.2	27.8
Width	19.9	22.5
Basihyal:		
Greatest extent across extremities of diverging arms, average 5 specimens	108.8	
Greatest length of arm (average of 11 specimens)	80.2	
Greatest width over facets for ceratohyals (average of 16 specimens)	37.9	
Antero-posterior diameter, measured between facets for ceratohyals (average of 18 specimens)	16.8	

VERTEBRAE.

The vertebral formula for *Mylodon harlani* is as follows: Cervicals 7, thoracics 16, lumbar-sacrals 9 or 8, caudals 21. The lumbar vertebrae have ankylosed with the sacral series in the North American species, as in *M. robustus*.

Cervical vertebrae.—In *Mylodon harlani* the length of the series of seven cervical vertebrae (plate 27, figs. 3 and 4) in close articulation is 273 mm. This measurement is actually smaller than the comparable measurement in *Nothrotherium*, and is indicative of the relatively short neck which *Mylodon* possessed. The individual vertebrae, in contrast to those in the megalonychid forms from Rancho La Brea, are decidedly compressed. The antero-posterior compression is shown particularly in cervicals following the axis.

The atlas of *M. harlani* resembles closely the corresponding vertebral segment in *M. garmani* and differs from that in *M. robustus* in the same way as does the species described by Allen. For example, the lateral borders of the wings may be straight, though in some specimens from the asphalt the curvature corresponds to that in the atlas of the South American species. On the dorsal surface this border is distinctly raised. The posterior border of the lateral process does not extend in back of the articulating surface for the axis as far as in the atlas of Owen's specimen, *M. harlani* and *M. garmani* thus being similar. This border reaches farther back than in the atlas of *Nothrotherium*.

Another resemblance between the two North American mylodonts and a character which separates them from *M. robustus* is the position of the two dorsal foramina on the lateral process, as already pointed out by Allen for *M. garmani*. In *M. harlani* the posterior foramen is situated considerably to the rear of the anterior depression. In *M.*

robustus these structures are very close together. In the atlas of *Scelidotherium magnum* shown by Winge (1915, plate 37), the two foramina are widely separated. An interesting difference between *Mylodon* and *Nothrotherium* is seen in the absence of the posterior superior foramen in the atlas of the latter genus. In *Mylodon harlani* the posterior border of the arch over the neural canal is carried farther back and allows a bridge of bone to arch over the dorsal furrow leading from the anterior dorsal depression to the posterior opening of the vertebrarterial canal. The anterior margin of the neural arch may be more deeply indented in median line in the atlas of *M. harlani* than in that of *M. robustus*, but this feature is variable.

In posterior view the dorsal arch of the neural canal is seen to be thick and the ventral arch apparently sags more posteriorly than in *M. robustus*. The facets for the axis face a little more directly to the posterior side than they do in the atlas of *Nothrotherium*. Also, external to these facets in *Mylodon harlani* there is a lateral expanse of bone, representing a downward deflection of the lateral wing, which is more extensive than in *M. robustus*. Such a pronounced deflection is entirely lacking in the atlas of *Nothrotherium*.

The depression on the ventral surface of the lateral wing, leading to the vertebrarterial canal, appears as a more prominent feature in the atlas of *M. harlani* than in that of *M. robustus*. It is relatively less extensive than in the atlas of *Nothrotherium*, and consequently the dorsal and posterior openings of the canal can not be seen in the floor of the depression. The anterior margin of the floor of the neural canal is not deeply concave, as in *Nothrotherium*. This bridge is relatively narrow and situated well posteriorly, in contrast to that of *Nothrotherium*. Its antero-lateral margins do not overhang the articulating surfaces for the occipital condyles as they do in *Nothrotherium*.

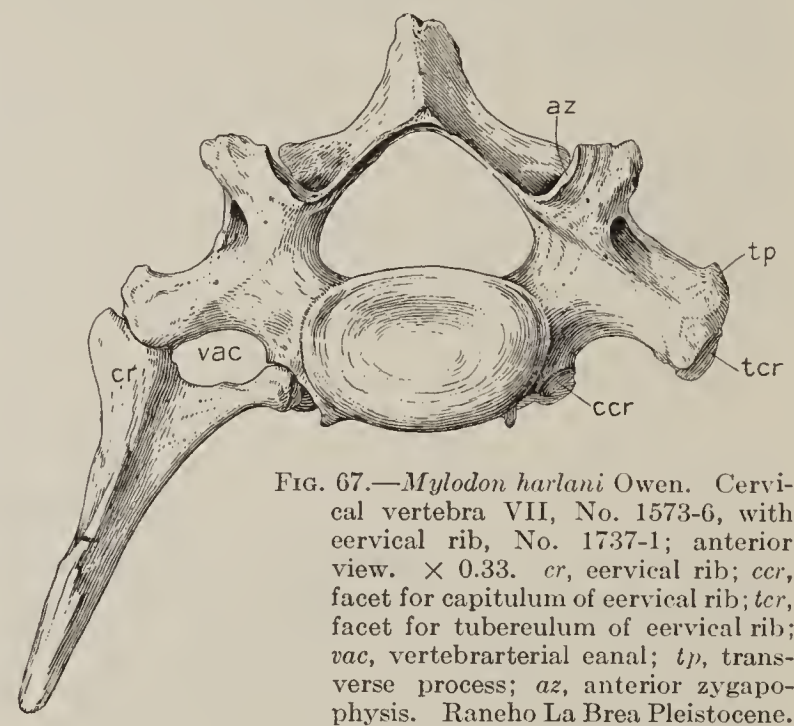


FIG. 67.—*Mylodon harlani* Owen. Cervical vertebra VII, No. 1573-6, with cervical rib, No. 1737-1; anterior view. × 0.33. *cr*, cervical rib; *ccr*, facet for capitulum of cervical rib; *tcr*, facet for tubereulum of cervical rib; *vac*, vertebrarterial eanal; *tp*, transverse process; *az*, anterior zygapophysis. Raneho La Brea Pleistocene.

The axis again resembles more closely the corresponding element in *M. garmani* than in *M. robustus*. Allen states (Allen, G. M., 1913, p. 328) that the axis of *M. garmani* "differs from that of *M. robustus* mainly in that the superior margin of the spinous process is at a much less angle to the long axis, due to greater elevation of its anterior projection." This is true also for the axis of *M. harlani*. Viewed from the top, the superior margin in most specimens is represented by a flattened surface anteriorly which changes posteriorly to a sharp ridge. In specimens of the axis belonging to exceptionally large individuals the superior margin of the spinous process is formed by a very broad surface extending the length of the process. The spinous process may somteimes be exceptionally long antero-posteriorly, in which case it overhangs the postzygapophyses to a considerable extent. In all the axes of *M. harlani* from Rancho La Brea the posterior border of the spinous process, extending from the postero-dorsal angle to the postzygapophyses, is concave, not convex, as in the axis of *M. robustus*.

With one exception, the facet on the lower side of the odontoid process is directed more to the ventral side than in the axis of *M. robustus*. The facet itself is usually convex, but may be concave in some specimens. The upper surface of the odontoid is smooth, and, according to Leidy, comes in contact with the transverse ligament. In *M. harlani* this surface is bounded posteriorly by a transverse ridge and assumes the

character of a broad transverse groove. The lateral articulating surfaces for the atlas are convex and ovate in shape. The principal diameter of the facet extends from the postero-dorsal side to the antero-ventral side. In a few specimens this diameter extends from the antero-dorsal to the postero-ventral side, with other axes showing degrees of variation between these two extremes. In one specimen the left lateral facet for the atlas is in direct connection with the facet on the ventral side of the odontoid.

The transverse process may be narrow or quite broad dorso-ventrally. It does not extend well below the lower margin of the lateral articulating surface, as in *Megalonyx jeffersonii*. The process is pierced by a large vertebrarterial canal. In *Mylodon harlani* this canal does not open also on the ventral surface at the base of the transverse process, as in *Nothrotherium*. The median keel of the ventral surface is prominent and broadens at either end.

Behind the axis the cervical vertebrae carry slender neural spines which increase in length and in antero-posterior diameter from the third to the seventh vertebrae, inclusive. In the seventh vertebra the neural spine is inclined and is wide posteriorly, with right and left margins of the posterior side distinct and crenulated. The neural spine in the seventh vertebra of *Mylodon* differs, therefore, in several characters from that in the corresponding segment of *Nothrotherium*.

TABLE 67.—*Measurements (in millimeters) of eight specimens of atlas of Mylodon harlani.*

	No. 1567–2	No. 1567–4	No. 1567–5	No. 1567–6	No. 1567–7	No. 1567–8	No. 1567–9	No. 1567–10
Greatest transverse width across lateral wings	211	212.8	232	225	223	237	214.7	218
Greatest antero-posterior diameter	83	77.7	91	90.8	87.3	96.8	87.8	86.5
Antero-posterior diameter of dorsal wall of neural canal along median line	46.4	47.9	51.8	57.4	47.8	53.5	51	46.4
Antero-posterior diameter of ventral wall of neural canal along median line	33.2	33.3	[1]38.3	43.9	41.4	40.7	37.4	38.4
Distance from antero-external border to lateral facet for axis	83.6	90.8	92	84.7	90	94.8	85.9	85.5
Greatest transverse distance between posterior borders of facets for axis	[1]111	93	98.8	89.4	98.2	102.3	95	98
Least transverse distance between anterior borders of facets for axis	55.5	39	52.3	41.3	43.8	46.3	43.3	46.2
Greatest antero-posterior diameter of lateral process	77.7	86	84.6	83.6	97.8	87	81	78

[1] Approximate.

The lateral wing of the third cervical is broad dorso-ventrally, with the upper outer end projecting backward as a distinct process. In the fourth vertebra the anterior (inner) and posterior (outer) ends of the lower portion of the wing-like process tend to thicken and to separate. This separation becomes more pronounced in the fifth cervical, where the anterior (inner) end projects as a flattened process, with long axis parallel to the fore-and-aft diameter of the vertebra, and representing apparently the inferior lamella. When the fifth vertebra is viewed from the anterior side, the inferior lamella is seen to extend well below the ventral surface of the centrum. In the fourth vertebra, on the contrary, the inferior lamella, as seen in front view, extends only slightly beneath that surface. In the sixth cervical the inferior lamella extends farther forward beyond the anterior face of the centrum than in preceding vertebrae. In the sixth cervical, also, the connection between inferior lamella and the outer lower portion of the lateral process that incloses the vertebrarterial canal on the lower outer side is quite narrow. In the preceding vertebrae this connection is broad.

The seventh cervical vertebra is relatively simple in structure of lateral process, but may show some interesting characters. As a rule, only a heavy lateral process is present, which projects slightly downward and may fuse with a rudimentary cervical rib. When

such fusion takes place the capitulum disappears entirely and the vertebrarterial canal remains open below, or the capitulum remains and a vertebrarterial foramen is formed comparable to that in preceding vertebrae. Specimen 1573–6 (fig. 67) is interesting in this connection, for a cervical rib actually articulates with this vertebra on the right side. Facets on the left side demonstrate the presence of the opposite rib, also with distinct capitulum and tuberculum. In the seventh cervical the inferior lamella is far more reduced than in the corresponding vertebra of *Nothrotherium*. As noted by Allen (1913, p. 328) for *M. garmani*, this vertebra possesses a large facet on each side of the lateral border of the posterior face of the centrum. In specimens from Rancho La Brea this facet may be concave or flat and articulates with the capitulum of the first costal rib. One specimen has been noted in which the facet was absent on one side.

In the series of cervical vertebrae from the third to the seventh inclusive the centra gradually broaden transversely and flatten dorso-ventrally. The median keel on the ventral surface of the centrum, most pronounced on the axis, tends to widen posteriorly in these vertebrae. It practically disappears in the fifth cervical.

TABLE 68.—*Measurements (in millimeters) of six specimens of axis of Mylodon harlani.*

	No. 1568–1	No. 1568–2	No. 1568–4	No. 1568–5	No. 1568–6	No. 1568–7
Greatest length along median line of ventral surface	88	86.8	84.4	92.3	82	87.6
Greatest height	134	141.3	139	143	138.9	141.2
Least width behind articulating surfaces for atlas	83.3	87.9	76	88	84	85.6
Dorso-ventral diameter of centrum across posterior surface	45.8	49.9	45	48.9	49.9	46.5
Greatest width of centrum	58.4	56.7	53	62.7	61.5	59.6
Greatest transverse diameter of neural canal at anterior end	61.4	49	46	49.8	45	48.6
Greatest width across posterior ends of transverse processes	163.4	153.2	141.4	146.8	163.2	155.9
Distance from anterior end of dorsal spine to posterior end of neural arch	78.2	70	67.9	81.7	69	71.7
Width across posterior zygapophyses	81.1	80.3	78.7	95	89.3	96.1
Least distance from anterior border of neural canal to border of notch below posterior zygapophyses	25.6	27.3	24.3	29.2	25.2	26.3
Greatest width across outer ends of lateral facets for atlas	100.6	100.9	85.8	102	97.3	102
Distance from anterior border of lateral facet for atlas to posterior end of transverse process	107.7	97.4	83.3	99.4	101.8	104.5

Thoracic vertebrae.—The first thoracic vertebra differs noticeably from that in *Nothrotherium* in possessing a slender spine without terminal enlargement. The spine is inclined backward and is approximately twice the length of that in the last cervical vertebra. The anterior zygapophyses are concave upward (plate 28, fig. 8), while the posterior zygapophyses are flat or slightly concave downward. The centrum is relatively shorter than in the first thoracic of *Nothrotherium*. The facet for the capitulum of the first rib is situated lower in the vertebra of *Mylodon*, extending nearly to the ventral border. The facet for the capitulum of the second rib is situated well along the lateral border of the posterior face. Nutrient foramina pierce both the dorsal and ventral surfaces of the centrum.

In the second thoracic the spine is slightly longer and wider than that in the first vertebra. The dorsal border of the spine meets the anterior border to form a distinct angle, in which respect this segment differs from the first. The centrum is still compressed dorso-ventrally; the flattened ventral surface is, however, not as wide as in the preceding vertebra. There is a noticeable decrease in the width across the transverse processes. A curious feature is seen on the right side of all the specimens of this vertebra examined from Rancho La Brea. The pedicle of the neural arch on this side of the vertebra is slender and the intervertebral space behind it, forming the exit for the spinal nerve, is very large. On the left side the intervertebral space is of normal size. A slender right pedicle and an enlarged intervertebral space may also occur in the third

thoracic vertebra. There appear to be some specimens, however, in which these structures are comparable in their development to those of the left side and are of the normal type.

A nearly complete series of thoracic vertebrae, presumably belonging to a single individual, is shown on plate 28, figure 1. The vertebrae have been tentatively determined as representing the third to fourteenth inclusive. In this series is clearly shown the change in the size and shape of the dorsal spines and the change in the size, shape, and position of the facets articulating with the ribs. The gradual development of the metapophyses should be also noted. The centra have concave sides and gradually increase in depth posteriorly. In each vertebra at least two nutrient foramina perforate the dorsal surface, while the ventral surface is pierced by similar foramina. The change in the shape of the anterior face of the centrum and in the size and shape of the neural canal can be seen in plate 28, figures 2, 3, 4, and 8. With the twelfth vertebra the ventral side of the centrum begins to flatten, and this character becomes more noticeable in the following thoracic segments. In the fourteenth the ventral surface is bounded on each side by a ridge. Several vertebrae in the middle portion of the thoracic series are uniquely characterized by a facet on the anterior and on the posterior side of the dorsal spine. These facets vary in size and shape and permit an articulation of the spines of the vertebrae. Such surfaces have been noted by Allen in thoracic vertebrae of *Mylodon garmani*. The anterior facet is situated at the flattened base of the spine, while the posterior facet lies frequently between the posterior zygapophyses and the middle of the posterior side.

TABLE 69.—*Measurements (in millimeters) of cervical vertebrae of Mylodon harlani, series 1569–3 to 1573–3 inclusive.*

Number in cervical series.	3	4	5	6	7
Length of centrum measured over ventral surface	38	37.5	37	38.6	42.2
Width across centrum measured over anterior face and between inner borders of vertebrarterial canals	75.3	76.7	77.2	81.3	94.2
Depth of centrum measured over anterior face and normal to dorsal surface	50.3	51.1	49.5	47	46.2
Height from ventral border of posterior face of centrum to tip of neural spine	136.5	138	.....	.....	.....
Width across outer sides of anterior zygapophyses	114	[1]131	133.7	146.8	138.9
Greatest width across posterior zygapophyses	91.7	93	92	94	[1]95
Greatest width across posterior ends of ventral wings	166	175.6	183	194.5	202
Length of ventral wing	45	64.4	63.8	59.5	43.3

[1] Approximate.

In the last four vertebrae of the complete thoracic series of *Mylodon harlani* the zygapophyses undergo an interesting change from the simple type of the anterior region of the trunk. In the first of these four vertebrae the anterior zygapophyses are broad, flat, articulating surfaces, situated close to the median line and at the base of the dorsal spine. The posterior zygapophyses may be represented also by two broad surfaces. In some individuals, however, the posterior zygapophyses may occur as two pairs of facets, in which case two large surfaces having a posterior position form the medial pair, while two small articulating surfaces form the lateral and anterior pair. Moreover, individuals are known in which a large and a small facet may be present on one side of the median line, while on the opposite side only a single large facet occurs.

In the second of the four vertebrae the anterior zygapophyses form articulating surfaces to correspond with those forming the posterior zygapophyses of the preceding vertebra. The outer facet, when present, is not on the same plane with the inner or medial facet, but is deflected downward. The posterior zygapophyses form two distinct pairs of articulating surfaces. On each side the inner or medial facet is situated at the base of the dorsal spine and a small extent of its surface is directed downward, while

the major portion is directed outward and downward. In some specimens this facet is directed downward for the most part. The outer or lateral facet is situated on the upper posterior side of the pedicle of the neural arch and is directed downward and inward.

In the third of the four vertebrae (see fig. 68) the medial facet (az^2) is usually separated from the lateral facet (az^1) by a strong ridge extending forward from the base of the metapophysis (m). The medial facet is concave upward, with the greater portion of the surface directed inward. The lateral facet is flat and is directed upward and outward. The posterior zygapophyses (see fig. 68) somewhat resemble those in the preceding vertebra. The medial facet (pz^2) is bent sharply upward along the side of the dorsal spine. This facet is separated by a deep notch from the lateral facet (pz^1).

In the last vertebra of the series, presumably the sixteenth of the entire thoracic series, the arrangement of the zygapophyses is similar to that in the preceding vertebra. The posterior articulating surfaces are rugose and frequently ankylose the vertebra to the sacrum.

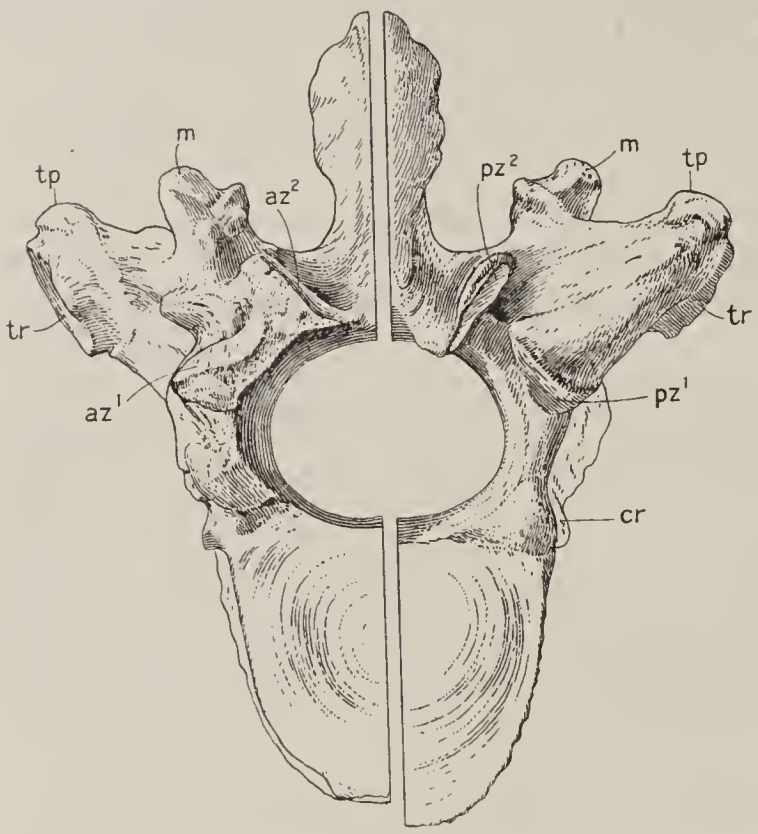


FIG. 68.—*Mylodon harlani* Owen. Thoracic vertebra XV, No. 1588–4, anterior and posterior views of right half. × 0.33. az^1, lateral anterior zygapophysis; az^2, medial anterior zygapophysis; pz^1, lateral posterior zygapophysis; pz^2, medial posterior zygapophysis; m, metapophysis; tp, transverse process; cr, facet for capitulum of rib; tr, facet for tuberculum of rib. Rancho La Brea Pleistocene.

Lumbar and sacral vertebrae.—The sacrum of *Mylodon* is a complex structure formed by the fusion of vertebrae in the posterior region of the trunk with the true sacral segments. In this respect *Mylodon* differs considerably from *Nothrotherium*. In *Mylodon robustus*, as described by Owen, the sacrum consists of 7 sacral vertebrae ankylosed with 3 lumbar vertebrae. In Owen's specimen the last thoracic is also attached to the lumbar series.

In many of the specimens from Rancho La Brea, 9 vertebrae form the sacrum. Thus the lumbar-sacral series in *M. harlani* lacks 1 vertebra present in *M. robustus*. Several specimens from the asphalt have been noted in which only 8 vertebrae occur in the sacrum. This is characteristic of No. 1719–25. In many sacra with 9 vertebrae the segments are completely fused and the neural spines form a continuous ridge over the series.

The 3 anterior vertebrae in the sacrum apparently represent the lumbar series. The centra are deep and have their ventral surfaces perforated by large nutrient foramina. In the first vertebra the transverse process may not be completely fused with the anterior inner margin of the ilium and large openings may persist in this region. The anterior zygapophyses are grouped in two pairs, as in the last thoracic vertebra. The neural canal increases in size throughout the series. The exits for the lumbar nerves are large. Extending obliquely downward and forward across the lateral face of the centrum from each of these openings is a well-marked groove. The last pair of nervous foramina through the neurapophysial plate of the lumbar region has the characters of the fourth pair in *M. robustus*, as described by Owen (1842, p. 65). The 5 pairs of foramina for the sacral nerves are also similar to those in *M. robustus*. In sacra having 8 vertebrae, 4 pairs of foramina for the sacral nerves are present. The neural canal continues to

TABLE 70.—*Measurements (in millimeters) of thoracic vertebrae of Mylodon harlani.*

Serial No.	[1]1574–3, 1575–3		[2]1576–3 to 1587–3											
Number in thoracic series	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Greatest length of centrum	46.7	[3]52.2	[3]55	[3]54.5	55	[3]57	59	[3]62	.....	.....	.....	63	65	.....
Depth of centrum measured over anterior face.	48.9	[3]48.9	52.3	56.2	59	58.6	58.9	59.4	.....	.....	62.2	63.2	68	72
Greatest width of centrum measured over anterior face	62.8	60.2	66.7	66	67.6	70.6	72.5	75.3	.....	.....	81	85.2	83	89
Height measured from median ventral border to top of dorsal spine	218.2	223	[3]210	193	192	191	185.2	.....	.....	194.7	[3]205	211	219.5	.....
Greatest width across transverse processes	195	172.2	177.2	174	176	183.3	187.2	190.4	199	205	200	198	190	186
Dorso-ventral diameter of neural canal at anterior end	38.7	40.4	42.3	46.8	46.4	54.5	56.6	54.5	58	58.5	58	59	60.3	56
Transverse width of dorsal spine at middle	17.3	19.2	19.2	22.3	18.3	16.5	17.6	.....	14.6	21	15.1	13.2	12	13.7
Transverse diameter of end of dorsal spine	21.2	31	26.2	25	25.5	22.6	20.7	.....	.....	22	26.2	29	30.3	.....
Greatest antero-posterior diameter of facet for tubercle of rib	.....	.....	24.6	26.8	26	22	23.3	21.3	20.7	21	23.5	25.2	28	33
Greatest dorso-ventral diameter of facet for capitulum of rib	.....	.....	42	36.4	40	41	.....	.....	.....	41	40	38	44.3	45
Least distance between facets for tubercle and capitulum of rib	.....	.....	19	23.4	30.2	46.6	51	51.5	47.5	49	52	57.5	50	55

Serial No.	[4]1576–4 to 1578–4			[5]1579–4 to 1583–4					[6]1586–4 to 1588–4			[7]1588–1, 1589–1	
Number in thoracic series	3	4	5	6	7	8	9	10	13	14	15	15	16
Greatest length of centrum	[3]52	62	59.4	56	63	[3]57.4	63.3	59.6	65.9	66.3	72.7	63.3	64
Depth of centrum measured over anterior face	[3]55.9	62.3	69	68.4	73	[3]68.3	71.5	68.8	72.4	76.2	83	82.2	82
Greatest width of centrum measured over anterior face	57.8	60	61.8	62.8	62	65	66.5	69.6	72.3	74.1	78	76.8	78.7
Height measured from median ventral border to top of dorsal spine	[3]232.5	228	222.5	206	215.8	207.5	222	.....	234	238.6	245.8	268	[3]243
Greatest width across transverse processes	175	172.3	177.5	186.2	184.8	186.2	186.2	187	180.3	184.4	.....	.....	.....
Dorso-ventral diameter of neural canal at anterior end	42	45.7	50.2	55	58.5	57.5	56.4	58.3	57.2	59.9	57.8	63.5	.....
Transverse width of dorsal spine at middle	21.5	23.2	25	20.5	20.3	21.5	28.8	23.5	21.7	21.3	23.4	26.6	.....
Transverse diameter of end of dorsal spine	32.7	30.5	32	31.4	28.4	29	.....	.....	37.9	39.4	38.6	36	.....
Greatest antero-posterior diameter of facet for tubercle of rib	30	22.8	27.9	28.7	24	26	18.9	22.9	24.9	30	27.5	.....	.....
Greatest dorso-ventral diameter of facet for capitulum of rib	27.2	36.1	33.3	26.4	42	41.4	37.9	43.4	44.5	53.6	46.7	.....	.....
Least distance between facets for tubercle and capitulum of rib	18.6	19.2	18.3	44.6	52.4	60	60.9	56.4	52	55.8	49.4	.....	.....

[1] Figured on plate 29, figs. 8 and 9.
[2] Figured on plate 29, figs. 1 to 4.
[3] Approximate.
[4] Figured on plate 29, fig. 5.
[5] Figured on plate 29, fig. 10. These vertebrae tentatively determined as sixth to tenth inclusive.
[6] Figured on plate 29, fig. 6.
[7] Figured on plate 29, fig. 7.

increase in size to about the middle of the sacral series and then decreases. The last sacral vertebra is wide transversely. A small facet for a chevron-bone may be present at each end of the ventral border of the posterior surface. Occasionally a small process may occur in this region.

Caudal vertebrae.—A representative series of caudal vertebrae of *Mylodon harlani* is shown in plate 29, figures 1 and 2. In this series the centrum reaches its greatest length at the end of the proximal third of the tail. Behind this region there is a gradual decrease in antero-posterior diameter to the end of the tail. The centrum reaches its greatest depth, as measured over the anterior surface, in the third or fourth vertebra. In the following segments a gradual decrease is noted in this measurement. The centra are similar in shape to those in *M. robustus*. The neural arch remains complete to approximately the end of the middle third of the tail. With the reduction of the arch the anterior and posterior zygapophyses become small and disappear. In the four anterior vertebrae of the series the transverse processes are stout structures, but are not as wide in fore-and-aft direction as in vertebrae of the middle portion of the tail.

In the first caudal a facet for the haemapophysis is present at each end of the ventral border of the posterior surface. In vertebrae behind the first, two pairs of facets are present, the two facets on the ventral border of the posterior surface being usually larger than those on the ventral border of the anterior surface. Between the haemapophysial facets of each side the lateral border of the ventral surface of the centrum may be notched, and from this notch extends upward and backward a groove to the posterior side of the transverse process. As indicated by Owen for *M. robustus*, this groove undoubtedly carried a vertebral artery from the haemal vessel. Occasionally the lower end of the groove may be inclosed by a bridge of bone. Specimens have also been observed in which the opening of the groove into the haemal canal is closed. In the region of the seventeenth vertebra the haemapophyses become quite small, and the facets for their articulation tend to disappear. The haemapophysial facets on the ventral border of the anterior surface of the centrum are usually the first to vanish. With the disappearance of the haemapophyses, the haemal canal extends backward as an open groove on the ventral side of the centra.

HAEMAPOPHYSES.

All the caudal vertebrae in *Mylodon harlani*, with the exception of those at the end of the tail, carry chevron-bones (plate 29). Where typically developed these elements are Y-shaped, in which respect *Mylodon* differs from *Nothrotherium*. In the first vertebra of the caudal series, where the facets for the haemapophysis are widely separated transversely, the right and left elements do not unite ventrally to inclose the haemal canal (plate 29, fig. 3). Each element articulates mainly with the posterior facet of the first caudal and tapers downward. The second haemapophysis is completely formed, the right and left elements joining below to form a wide V-shaped canal (plate 29, fig. 4). Below this union extends a short spine. Each arm of the chevron is broad antero-posteriorly and carries at the upper anterior and posterior end a facet that articulates with second and third vertebra respectively.

In the following four haemapophyses there is to be noted a gradual lengthening of the elements ventrally and a broadening antero-posteriorly of the haemal spines. With the narrowing of the caudal vertebrae and the close proximity of right and left facets for the chevron-bones, the two arms of the haemapophysis approach each other more closely at the upper ends. In the middle region of the tail the haemapophyses are broad antero-posteriorly and the haemal spine forms a distinct keel (plate 29, figs. 5 and 6). Posterior to about the ninth chevron-bone the elements show gradual reduction in size, but the spine may remain broad to the thirteenth. Behind this haemopophysis the fourteenth and fifteenth elements still articulate by anterior and posterior facets with the caudal vertebrae.

COSTAL RIBS.

There are presumably sixteen pairs of costal ribs in *Mylodon harlani*, a number similar to that in *M. robustus*. The anterior ribs are joined below with the ossified sternal ribs. The first costal rib is short and broad and is firmly united with the sternal rib in adult individuals. Occasionally the ribs immediately behind the first also coossify with the sternal ribs. The costal ribs over the middle portion of the body are strong, broad elements, increasing in thickness at the lower ends. In the series the capitulum and tuberculum gradually move apart and are widely spaced in the posterior region. At the end of the series the head and tubercle tend to fuse with the thoracic vertebrae with which they articulate. In the last thoracic vertebra the rib is greatly reduced in length, is firmly united with this segment, and has the appearance of a laterally extended transverse process.

TABLE 71.—*Measurements (in millimeters) of caudal vertebrae of Mylodon harlani, series 1590–1 to 1609–1 inclusive.*

	No. in caudal series.									
	1	2	3	4	5	6	7	8	9	10
Height from ventral border of posterior face	149.6	139	134.2	131	125.7	115.6	104.8	.....	82.3	75.5
Length of centrum	54.2	56.5	59	60.3	59.8	60.3	61	61	60.2	59.1
Width of centrum across anterior face	77.2	70.7	69.6	67.3	65.1	65.3	65.3	62.3	59.2	53
Depth of centrum across anterior face	64.2	65.6	66	66	63.3	60.3	57.6	56.3	53.1	51.7
Greatest width across transverse processes	[1]255	251	246	236.2	213	204.5	178	160	134.9	112
Greatest width across metapophyses	101.6	109.8	108.6	104.2	97.2	91.7	76.2	67.2	53	50.3
Greatest width across posterior zygapophyses	70.5	72.2	64.4	61	51	38.8	32.7	.....	28.7	21.4

	No. in caudal series.										
	11	12	13	14	15?	16	17	18	19	20	21
Height from ventral border of posterior face	64	49.7	43.4	....	....	....	....	....	....	....	....
Length of centrum	55	51.5	49.5	47	46.9	43.3	42.6	38.8	37.6	29.3	....
Width of centrum across anterior face	52.6	50.5	47.4	46.8	44.5	42.5	37.7	35.5	33.4	28.4	....
Depth of centrum across anterior face	52.8	46.6	42.4	43	39	38.6	34.2	31	29.4	26.3	....
Greatest width across transverse processes	95	92	79.7	59.4	69.6	56	43.4	42.6	39.9	33.5	....
Greatest width across metapophyses	41	[1]45	....	39.2	41.5	30.3	30.5	....	27.7	21.3	....
Greatest width across posterior zygapophyses	14.1	....	....	....	....	....	....	....	....	....	....

[1] Approximate.

STERNAL RIBS.

The sternal ribs (plate 30) inclose the thoracic cavity ventrally and afford with the sternum a framework of considerable strength. The series in *M. harlani* consists of at least 10 elements resembling those in *M. robustus*. Usually 7 of the ribs join with sternal segments, while the eighth, ninth, and tenth do not reach the sternum, but overlap each other. The first sternal rib is very often fused with the vertebral rib, as in *Nothrotherium*. The sternal ribs gradually increase in length from the first back to the seventh. Connection between adjacent ribs begins with and continues behind the fifth.

In the third and fourth sternal ribs the ventral portion of the medial articulation for the sternum is usually symmetrical. In following ribs this articulation with the sternum becomes asymmetrical with reference to a transverse axis.

The fifth rib establishes a connection with the sixth by an elongate surface directed downward and situated near the middle of the posterior border. In the sixth rib a corresponding surface is situated on the anterior border and faces upward. The postero-lateral end of the rib is truncated obliquely by a large roughened surface that was connected by cartilage with the seventh rib.

The seventh sternal rib is the longest and stoutest of the series. The medial articulation varies somewhat in shape, depending on the structure of the sixth and seventh sternal segments. The lateral half of the rib broadens antero-posteriorly, is thick in front, and thins to the posterior edge. At approximately the middle of the anterior border is situated the roughened surface for union with the sixth sternal rib. In some specimens of the seventh sternal rib a small surface may be elevated above the ventral side and serves for attachment of the medial end of the eighth rib. Occasionally this surface migrates to the posterior border. In such specimens the postero-lateral end of the rib is truncated as in the sixth and serves also for cartilaginous attachment of the eighth rib. In other words, the eighth rib may in some individuals join at two places with the seventh rib, in others only the medial end extends over the ventral surface of the seventh.

The sternal ribs posterior to the seventh resemble those seen in species of *Mylodon* from South America.

STERNUM.

The segments comprising the sternum in *Mylodon harlani* (plate 30, figs. 1 to 6) number seven in all, and are comparable in their general characteristics to those of South American ground-sloths of the Pleistocene. The manubrium is the largest and most conspicuous of these elements, forming a broad plate. Sternal segments II to V inclusive possess individually the peculiar pawn-like structure, commonly found in ground-sloths and permitting a double articulation with the sternal ribs. Segments II, III, and IV have the ventral process elongated antero-posteriorly, while in No. V the process is usually much shorter. The sixth segment may have also a ventral process, but this element is sometimes represented only by a dorsal plate.

Occasionally other variations may be noted in this region of the sternum. The dorsal plate sometimes consists of a right and left piece not fused in median line, while the ventral head also remains separate in some specimens (see plate 30, fig. 3). The teratological characters exhibited by the sixth sternal segment in some individuals of mylodont sloths from Rancho La Brea are a result of ossification of this element from several centers, which have not united in later development. Such variations are known to occur in other mammals,[a] but in *Mylodon* they seem to be restricted to the sixth segment of the sternum. With what degree of frequency a median cleft occurs in the metasternum can not be adequately ascertained, because of the very limited number of specimens of that element that are available. The xiphisternum possesses a thick median ridge ventrally, but the development of a distinct ventral process does not occur in *M. harlani*. The last segment, thinning to the posterior border, has more the appearance of that of *M. robustus*.

There is a gradual increase in transverse width of mesosternum from the second to the fourth segment, the latter having the greatest width of the mesosternal elements. Posterior to the fourth, a gradual decrease in this measurement occurs to the xiphisternum. The dorsal surface, particularly in the middle region of the sternum, may become

[a] A. M. Paterson. The human sternum. Three lectures delivered at the Royal College of Surgeons, England, November, 1903. London, 89 pp., 10 plates, 1904.

quite concave. This is especially noticeable in the fourth segment, which is broad. Union of elements sometimes occurs in the sternum of *Mylodon harlani*. Specimens are present in the collections from Rancho La Brea, in which the first and second segments are united, several in which the second and third are fused, and one in which the third and fourth segments are fused.

A downward deflection of the sixth segment may be occasionally noted in side-view of the sternum. The xiphisternum is apparently always somewhat deflected downward from the plane of the sternum.

The individual elements of the sternum of *M. harlani* are discussed more in detail below.

The manubrium is a broad element (plate 30, fig. 1), with ventral surface concave in antero-posterior axis and convex in transverse direction. The dorsal surface may be divided into three principal areas, of which the median concave one is by far the most extensive. Anterior to this concavity and on either side of the median line lie the comparatively large excavations that lodge the medial ends of the clavicles. Along the sides of the median concave area are situated the facets for the first sternal rib. The anterior portion of each facet faces more toward the dorsal side than in *Nothrotherium*. The manubrium of *Mylodon harlani* is thickest at the posterior end, where it articulates with the second sternal segment and with the second sternal ribs. The surface for the second sternal segment is directed posteriorly, not decidedly to the dorsal side as in *Nothrotherium*, thus indicating that the manubrium was not bent so sharply from the rest of the sternum.

All specimens of the first sternal segment of *M. harlani* differ from the corresponding element in *M. robustus* in shortness of that portion of the segment anterior to the dorsal concavity, and in the greater transverse width across the anterior border of the concavity. The transverse diameter anteriorly is also much greater in the manubrium of the Rancho La Brea form than in that of *M. gracilis*.

The measurements (in millimeters) of manubrium (average of 25 specimens) are: greatest antero-posterior diameter, 134.5; greatest transverse diameter, 128.5; greatest thickness at posterior end, 42.7.

The second sternal segment has the plate-like dorsal piece tapering considerably toward the anterior end. The anterior border is usually convex. The dorsal or internal articulating surface at the anterior end is continuous ventrally along the sides, with facets for the second sternal ribs. These in turn join below with another articulating surface for the manubrium. It is to be noted that the articulation for the second sternal rib forms a single surface, not divided into an upper and a lower part, as at the posterior end or in the sternal elements that follow. The conformation and extent of the facets at the anterior end of the second sternal element vary considerably. In a number of specimens all four facets merge to form an extensive anterior surface, for the most part convex in transverse direction, concave in dorso-ventral direction. The ventral knob or process is elongated in antero-posterior diameter. There are more specimens preserved in which this knob bears posteriorly a facet for the following sternal element than those in which it is lacking.

The measurements (in millimeters) of sternal segment II are: Greatest length over dorsal face (average of 21 specimens), 62; greatest width at posterior end (average of 21 specimens), 56.6; depth through middle (average of 21 specimens), 44.9; length of ventral keel (average of 19 specimens), 64.5; width of ventral keel at posterior end (average of 19 specimens), 44.9.

The third sternal segment is similar to sternal segment II in being longer than wide. At each end is present the full complement of facets for articulation with the sternal ribs, namely, two above, situated at the angle formed by the anterior and lateral

borders, and two below, which are larger than those above and situated on each side of the end of the ventral process. The articulation of the ventral knob with that of the segment in front and behind is variable. This is indicated by a variable presence of the median facet in front and behind.

The measurements (in millimeters) of sternal segment III are: Greatest length over dorsal face (average of 22 specimens), 60.4; greatest width at posterior end (average of 23 specimens), 71.7; depth through middle (average of 24 specimens), 45.7; length of ventral keel (average of 18 specimens), 57.3; width of ventral keel at posterior end (average of 20 specimens), 43.6.

In the fourth sternal segment the mesosternum reaches its greatest width, the transverse measurement of this element being always decidedly greater than the antero-posterior diameter. The ventral keel is usually large and massive. It often reaches its greatest depth toward the posterior end.

The measurements (in millimeters) of sternal segment IV are: Length along median line of dorsal side (average of 27 specimens), 59.6; greatest width of dorsal piece (average of 27 specimens), 79.1; greatest depth (average of 25 specimens), 50.7; antero-posterior diameter of ventral keel (average of 24 specimens), 54.7; width of keel (average of 24 specimens), 45.8.

TABLE 72.—*Measurements (in millimeters) of xiphisternum of Mylodon harlani.*

	No. 1726–2.	No. 1726–6.	No. 1726–10.
Greatest length.....	67	[1]89	96.5
Greatest width at anterior end.	45.2	57.7	70.2
Depth.....	21.5	28	28.6

[1] Approximate.

The fifth sternal segment is not so wide as the fourth, indicating that the sternum narrows gradually behind the latter and toward the xiphisternum. The ventral keel is also distinctly shorter in antero-posterior diameter as compared to that of the fourth. This causes the two lower facets for sternal ribs on each side and end of the keel to approach each other more closely and makes the interspace of less extent. The ventral keel is deepest toward the posterior end. The articulating surface of the dorsal plate with that of the sixth segment is usually convex in transverse direction.

The measurements (in millimeters) of sternal segment V are: Length across dorsal plate (average of 16 specimens), 62.5; greatest width at posterior end (average of 16 specimens), 72.1; greatest depth (average of 13 specimens), 54.3; total length of ventral keel (average of 15 specimens), 43.7; greatest width of ventral keel (average of 14 specimens), 37.7.

The sixth sternal segment is remarkable for its variable shape and structure. When completely formed it resembles the sternal segments anterior to it in having a dorsal plate which subtends a peduncle with an articulating head. This head or keel is noteworthy because of its shortness. The four facets which it bears approach each other very closely and often become confluent, remaining demarcated only by the distinct angle between them. The keel seldom reaches so far posteriorly as to lie well between the postero-lateral facets of the dorsal plate, thus differing from sternal segment V. The posterior articulation for the xiphisternum may be concave or sharply indented. A peculiar feature noted in a number of specimens is the separateness of the ventral head. Sometimes it has apparently disappeared entirely, for there is no sign of an articulating surface on the ventral side of the dorsal plate. In other specimens a distinct but small facet occurs in the median line of the plate. Corroborative evidence is sup-

plied by the presence in the collections of specimens which undoubtedly represent the ventral part of this sternal segment, and which possess a small facet that articulates with a corresponding facet on the dorsal plate. In 16 specimens of sternal segment VI, 5 have the ventral keel fused with the plate, 4 specimens indicate the presence of the ventral keel as a separate element, and the remaining 7 lack the keel and do not exhibit its presence by the small facet on the ventral surface. It is possible that in the latter group the ventral keel was actually present but very loosely connected with the dorsal plate. Finally, an added peculiarity to be noted in this segment of the sternum is the division of the dorsal plate into a right and left piece, a separation that has occurred in 5 of the 16 specimens under observation.

The xiphisternum resembles that in *Mylodon robustus*. The anterior border may be straight or may slope away on each side of a median apex. The dorsal surface may be flat or distinctly concave anteriorly. On the ventral side and at the two antero-external corners are the small facets for the last sternal rib to articulate with the sternum. In median line a tumid keel is developed which does not possess facets. Posteriorly this keel gradually sinks into the dorsal plate. The posterior margin is rounding and was probably fringed with cartilage.

Two specimens are noted in which xiphisternum has fused with the sixth sternal segment.

TABLE 73.—*Average measurements (in millimeters) of scapulae of Mylodon harlani.*

Length, measured from outer border of glenoid cavity to supra-scapular border and along the base of the spine	327.7
Greatest length, measured from end of clavicular facet to supra-seapular border and parallel to length of spine	435
Greatest width of blade, measured between ends of supra-scapular border	422.1
Width measured below base of spine	227.3
Height, measured from inner border of glenoid cavity to point directly above on surface of acromial process	162.5
Greatest antero-posterior extent of glenoid cavity	117.5
Greatest transverse width of glenoid cavity	72.3
Greatest width of coraco-acromial arch	68.2
Greatest diameter of supra-seapular aperture inclosed by coraeo-acromial arch	168.4
Greatest diameter of coraeo-scapular foramen	29.9
Greatest extent of elavicular faeet	41.6

SCAPULA.

The lateral aspect of the scapula (plate 31, fig. 1) differs from that of *Mylodon robustus* in the unequal areas separated by the spine. In *M. harlani* the prescapular fossa is broader than the postscapular fossa, while in the South American species, and also in *M. garmani*, the spine divides the lateral surface into two nearly equal parts. The inequality in size of these fossae is also a feature noted in the scapulae of *Nothrotherium* and *Hapalops*. The spine is sharply defined in the Rancho La Brea species, with the anterior and posterior borders usually diverging dorsally toward the supra-scapular border. In *Nothrotherium* the spine is not broad dorsally, nor are its borders so well defined as those of *Mylodon*. It sinks gradually into the dorsal surface of the scapula. The size and shape of the coraco-scapular foramen varies considerably in the scapula of *Mylodon harlani*. It may be relatively smaller than the similar foramen in the scapula of *Nothrotherium*, or it may be very large, in which specimen it greatly exceeds the size in *M. robustus* and in *M. garmani*.

In specimens belonging to young individuals (No. 1715–L–12, for example) the coracoid element is still distinctly defined by suture. It becomes evident that the greater portion of the border of the coraco-scapular foramen is formed by the coracoid. In specimen 1715–L–12, where the anterior border or epiphysis of the coracoid is lacking, due to immaturity, this bone possesses a striking similarity to the reptilian "coracoid" in shape. The coracoid is excluded from the glenoid cavity, as shown by Ameghino. It is, however, intimately connected with the epiphysial element forming

the anterior part of the glenoid articulating surface and designated metacoracoid by Ameghino.

The acromian is evidently still separate in young individuals, but in the mature animal it is firmly consolidated with adjacent structures to form a complete span of bone from the scapular spine to the coracoid region.

CLAVICLE.

The clavicle (plate 31, fig. 2) is a strongly developed element of approximately twice the size of that in *Nothrotherium*. The shaft is somewhat compressed and has a double curvature. At the outer end of the shaft an oval, convex surface articulates with a facet on the acromial arch of the scapula as in *M. robustus*. The opposite end of the clavicle is tuberous, giving a broad surface for attachment to the first sternal segment.

TABLE 74.—*Average measurements (in millimeters) of clavicle of Mylodon harlani.*

Greatest length	220.9
Least width of shaft at middle	19.9
Greatest width at outer end below scapular facet	21.6
Long diameter of scapular facet	33.6
Greatest width of sternal end	62.3
Greatest thickness of sternal end	27.9

HUMERUS.

As suggested by Owen (1842, p. 81) the humerus of *Mylodon* differs from that of the megalonychid ground-sloths in being heavily constructed. This is clearly shown by the size of the shaft and of the extremities (see plate 32). *Mylodon* differs also noticeably from *Megalonyx* and *Nothrotherium* in the absence of the entepicondylar foramen.

In anterior view of the humerus (plate 32, fig. 2) the head is seen to be not very prominent, rising but slightly above the level of the greater tuberosity. Occasionally the head may be even less prominent, the articulating surface lying below this level. The long axis of the proximal articulating surface has an antero-posterior direction. The greater tuberosity is particularly large. In the groove between the tuberosities and the head are lodged a number of large nutrient foramina. The pectoral ridge varies in distinctness, as does also the eminence which terminates the ridge distally. The pectoral ridge is never quite so well defined as it is in the humerus of *M. robustus* figured by Owen. The deltoid ridge, overhanging the musculo-spiral course, is a noticeable feature in the humerus of *Mylodon*, showing greater prominence than in the megalonychid ground-sloths. As in the latter, this ridge becomes better defined in old individuals.

Distally the humerus is broad, with expanded pronator and supinator plates above the distal trochlea. The articulating surfaces for radius and ulna are broad antero-posteriorly. The surface for the ulna is flattened considerably in this direction, more so than in the humerus of the megalonychid forms. The posterior surface of the humerus above the distal trochlea is broadly concave, but as a rule the olecranon fossa is not so distinct as in *Nothrotherium*.

The medullary foramen is frequently absent. When present it has a position at about the middle of the posterior surface and is relatively small.

TABLE 75.—*Average measurements (in millimeters) of humeri of Mylodon harlani.*

Length through middle of shaft, measured from proximal articulating surface to middle of distal articulating surface	429.6
Length from proximal end of greater tuberosity to distal end of radial surface	456.9
Greatest antero-posterior diameter of head	123.8
Greatest width across tuberosities	172.2
Distance from greater tuberosity to distal end of deltoid ridge	296.8
Greatest width of shaft measured at outer end of deltoid ridge	122.6
Antero-posterior diameter of shaft at distal end of deltoid ridge	79.3
Greatest distance between inner and outer tuberosities of distal end, measured obliquely across distal expansion	261.4
Width of distal trochlea	133.2

ULNA.

The ulna of *Mylodon harlani* (plate 33, figs. 1, 2, and 3) resembles in many characters that of *M. robustus* (Owen, R., pp. 83 to 86). This element of the forearm is shorter and much heavier than that of the megalonychid ground-sloths. The shaft is very broad and is compressed. The two sides of the shaft below the articulation for the humerus are concave. As indicated by Owen, the olecranon process is characterized by great size and is bent obliquely inward. The coronoid process is also prominent. The outer articulation for the humerus presents a broad, flattened or slightly concave surface, while the inner articulation is deeply concave. The surface for the radius is relatively small. The shaft thickens distally and terminates by an oblique truncation. The surface for the cuneiform is very broad and flat.

TABLE 76—*Average measurements (in millimeters) of ulnae of Mylodon harlani.*

Greatest legenth	395.9
Distance from end of olecranon process to summit of coronoid process	199.6
Width from posterior border to summit of coronoid process	161.2
Greatest thickness at distal end of shaft	69.1
Greatest width at distal end of shaft	90
Greatest width of distal articulating surface	55

RADIUS.

This element of the forearm, (plate 33, figs. 4, 4*a*, 4*b*, and 5) also conforms closely in its characters to that of *Mylodon robustus* as described by Richard Owen (1842, pp. 86, 87; plate 14). The radius is much shorter and heavier than that of the megalonychid ground-sloths *Megalonyx* and *Nothrotherium*. The proximal articulation is distinctly concave and elongated in the axis that extends from the ulnar to the outer border. The articulating surface for the ulna is convex. Below this surface the middle portion of the shaft may be deeply scarred where the interosseous membrane attaches. The ulnar border of the distal articulating surface may be broadly concave or notched in the middle. The outer border and the posterior or outer surface of the radius possess the detailed structural characters described by Owen for *Mylodon*. The anterior or inner surface is relatively smooth.

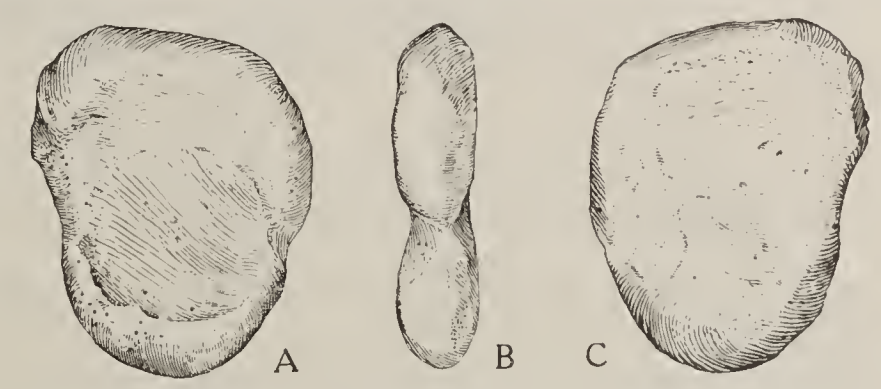


FIG. 69.—*Mylodon harlani* Owen. *A*, *B*, and *C*, views of falciform bone of manus, No. 1700–19. × 0.50. Rancho La Brea Pleistocene.

The average measurements (in millimeters) of 21 specimens of the radius of *Mylodon harlani* are as follows: Greatest length measured from proximal end to end of styloid process, 296.1; long diameter of proximal end, 77.5; short diameter of proximal end, 60.4; greatest length of distal end, 120.3; greatest width of distal end, 81.7.

FALCIFORM BONE OF MANUS.

Winge[a] has demonstrated the presence of the os falciforme manus in *Catonyx giganteus* and in *Scelidotherium magnum*, and states that the element was designated by Lund the os proprium flexorum manus. Winge notes that the falciform bone is a sesamoid situated in the palm of the hand and lying in the tendons of the flexor digitorum profundus muscle.

In the collections from Rancho La Brea, 30 specimens are available of an element (fig. 69, A, B, C) which is very similar in structure to the os falciforme manus of *Scelidotherium magnum* as shown by Winge, and undoubtedly represents this sesamoid bone

[a] Jordfundne og nulevende Gumlere (Edentata) fra Lagoa Santa, Minas Geraes, Brasilien. Med Udsigt over Gumlernes indbyrdes Slaegtskab, E. Museo Lundii, vol. 3, part 2, p. 162, plate 31, and pp. 201, 202, plate 39. 1915.

in the manus of *Mylodon harlani*. The series seems divisible into two parts, representing the right and left manus, this division being based upon the shape of the element and the surface appearance of the bony texture. One division includes 20 specimens, the other 10 specimens.

The falciform bone is a compressed element, somewhat elongated, with one end broader than the other. It is entirely devoid of articulating facets. One of the principal faces is generally somewhat concave, while the opposite face is more or less flattened. The borders are smooth and rounding. Considering the 20 specimens which appear to belong to one side, we note the following average measurements: Greatest length, 61.5 mm.; greatest width, 46.2 mm.; greatest thickness, 15 mm.

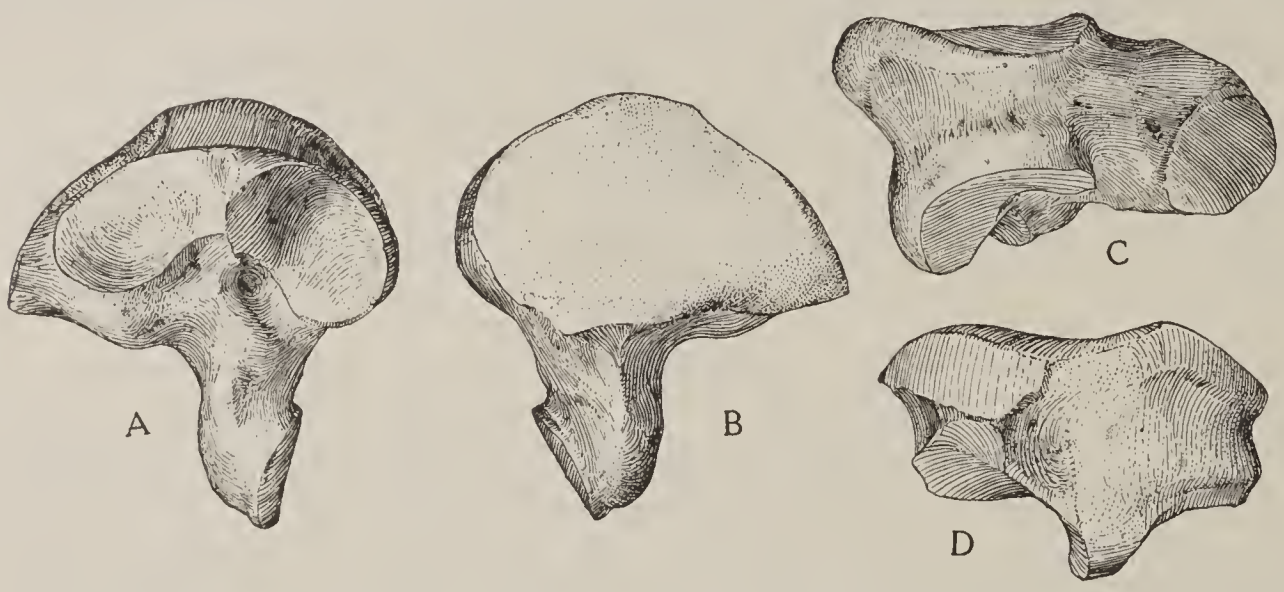


FIG. 70.—*Mylodon harlani* Owen. Right scaphoid, No. 24261 U. C. C. *A*, distal surface with facet for trapezoid at right and facet for magnum at left; *B*, proximal surface with articulation for radius; *C*, dorsal view with facet for trapezium at right; *D*, dorso-external view. × 0.50. Rancho La Brea Pleistocene.

SCAPHOID.

This carpal element (fig. 70, A to D) has been described by Lull (1915, p. 368), from whose description the following may be quoted:

"The bone is roughly triangular when viewed from above, with a rounded antero-internal angle and a deeply concave postero-external side. Three-quarters of the superior surface is articular and is convex in both dimensions in its outer part, becoming concave first along the transverse diameter and then in all directions in the broadly expanded inner portion. The anterior aspect of the bone is continuous with the outer face and the latter bears a rather long, narrow lunar facet which is continuous with that of the upper aspect though demarcated by a pronounced angle. The lower margin bears two deeply rounded bays, the limits respectively of the magnum and trapezoid facets. Except for the facets the entire surface of the bone is highly rugose. Posteriorly the bone is prolonged into a compressed angle bearing on its external face a sub-circular facet with which articulated the metacarpal of the first digit. When the bone is held with the superior face horizontal, this facet nearly coincides with the vertical antero-posterior plane. In its proper orientation, however, as indicated by the distal end of the radius, the upper surface of the scaphoid is inclined sharply downward and outward, which inclines the metacarpal facet obliquely downward in such a manner as to make the articulation feasible."

In Rancho La Brea specimens the articulating facet for the lunar may be continuous below by a narrow strip with the surface for the magnum, but distinguished from the latter by a sharp angle. The facets for trapezoid and magnum, where they approach each other most closely and are sometimes confluent, are situated on either side of a prominent projection (fig. 70, A and D). In *Megalonyx* the articulation with the magnum consists of two distinct facets instead of the single surface seen in *Mylodon*. In the manus of *Hapalops* the articulation between scaphoid and lunar is much more extensive than that of *Mylodon*. There is, however, but a single facet for the magnum as in the latter form, while the articulation between scaphoid and trapezoid is much more extensive in the Miocene genus and includes an additional facet close to the palmar border.

Owen (1842, pp. 87, 88) considers, in the description of the scaphoid, that the prominently developed process in this element represents the trapezium. There seem good reasons for believing, however, that the trapezium has not united with the scaphoid to form the scapho-trapezial element in *Mylodon*, but that it has in reality fused with the first metacarpal. This has already been indicated by Anthony,[a] who states:

"La main pentadactyle du *Mylodon* pleistocène a pu sembler à certains auteurs avoir possédé un véritable scapho-trapèze en connexion avec le premier doigt. Mais cette interprétation du scaphoide du *Mylodon* comme un scapho-trapèze est très vrai-semblablement erronée, étant donné qu'il est probable qu'à l'état jéune le ler segment du ler doigt de cet animal présentait un élément pouvant être interprété comme un trapèze.

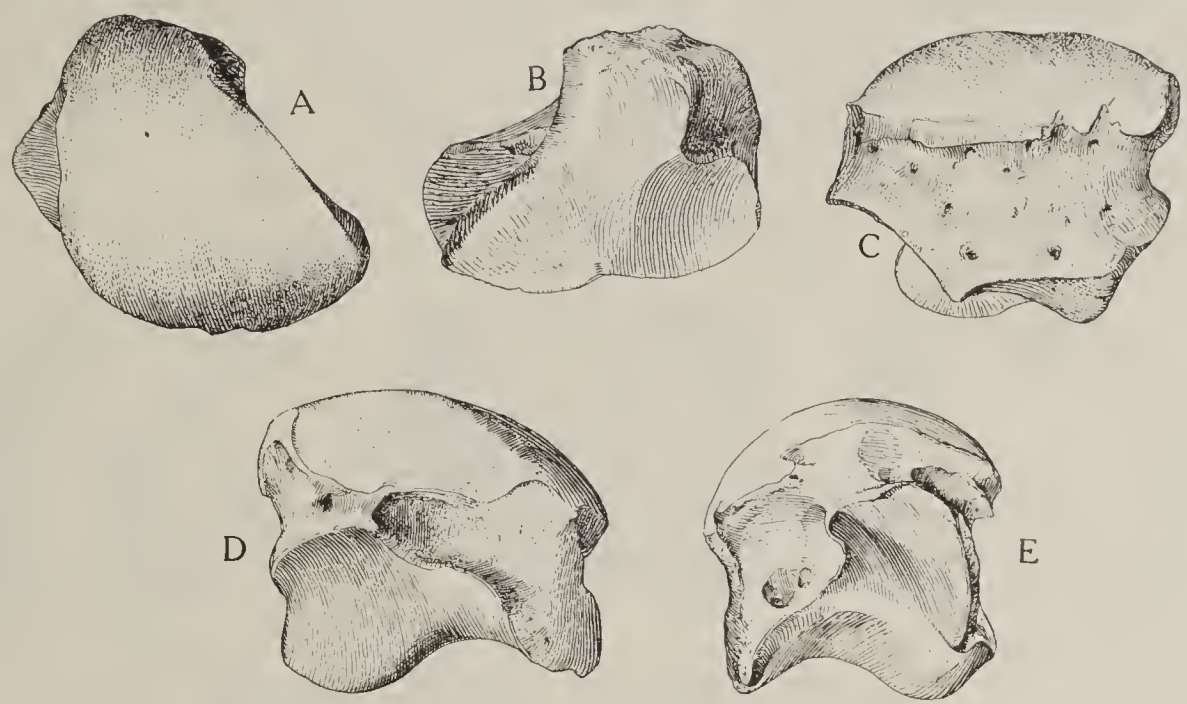


FIG. 71.—*Mylodon harlani* Owen. Right lunar, No. 24262 U. C. C. *A*, proximal view of articulating surface for radius; *B*, distal view with surface for unciform in middle, a small portion of facet for magnum shown on left, and facet for cuneiform on right; *C*, dorsal view; *D*, inner view with surface for scaphoid above and that for magnum below; *E*, outer view. × 0.50. Rancho La Brea Pleistocene.

The primitive relation of the elements in question is well shown in the Miocene genus *Hapalops*, a manus of which (No. 15171, Prin. Univ. Coll.) is available for comparison with that of *Mylodon*. In *Hapalops* a process of the scaphoid is well developed and bears upon its distal side an elongate facet for the trapezium. This process is undoubtedly homologous with the corresponding structure of the scaphoid of *Mylodon*. In the Miocene genus the trapezium is a separate element of relatively large size. It articulates proximally with the scaphoid, laterally with the second metacarpal, and distally with the first metacarpal. There is no articulation between trapezium and trapezoid. This position of the trapezium causes the first metacarpal to be well separated from metacarpal II, a feature which characterizes also the manus of *Mylodon*. In *Hapalops* the trapezium and metacarpal I when articulated approximate closely in shape the corresponding element in *Mylodon*. In the latter genus, however, the articulating surface for metacarpal II is much less extensive, and this is true also for the scaphoid articulation. Thus the weight of evidence seems to indicate that the trapezium has fused with the first metacarpal and not with the scaphoid.

The average measurements (in millimeters) of 39 specimens of *Mylodon harlani* are as follows: Greatest distance across articulating surface, 75.3; greatest distance from border of facet for metacarpal I to border of radial surface, 82.8; distance from radial surface to tip of distal process measured normal to radial surface, 45.3.

[a] R. Anthony. Recherches anatomiques sur les Bradypes arboricoles le squelette du Paresseux a collier; ses rapports morphologiques avec celui des autres bradypes. Ann. Sci. Nat., Ser. 9 (Zool.), vol. 9, p. 238. 1909.

LUNAR.

The proximal surface of the lunar (fig. 71 A) articulating with the radius is convex in dorso-palmar extent and narrows toward the palmar border to less than one-half the transverse width of the surface dorsally (figs. A to E). This decrease in width is brought about by the obliqueness of its inner border, indicating the scaphoid surface. When the lunar is placed in normal relation to the remaining elements of the carpus, the radial surface slopes steeply inward. The radial surface encroaches well upon the dorsal face of the lunar, from which it is separated by a decided offset. Along the inner side (fig. 71 D) the radial surface is continuous with an articulating area for the scaphoid. The latter surface is widest toward the dorsal side. In distal aspect of lunar (fig. 71 B) three articulating surfaces are seen. An inner concave facet for the magnum is continuous at a pronounced angle with the narrow surface for the unciform. The latter is the principal surface of the distal end, conforms in shape to that on the unciform with which it articulates, and is continuous externally, at an obtuse angle, with the third articulating area, a small concave facet for the cuneiform.

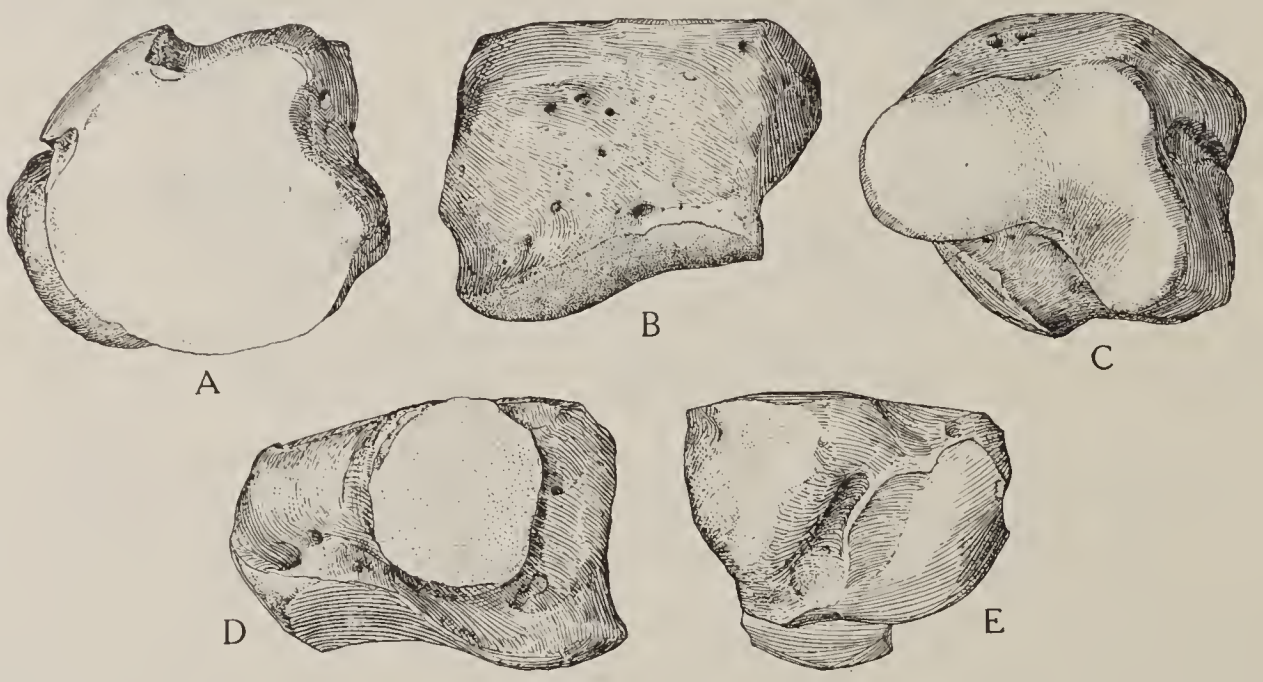


FIG. 72.—*Mylodon harlani* Owen. Right cuneiform, No. 24263 U. C. C. *A*, proximal view of ulnar surface; *B*, dorsal view; *C*, distal view of surface for unciform; *D*, palmar view showing facet for pisiform; *E*, inner view with facet for lunar. × 0.50. Rancho La Brea Pleistocene.

The average measurements (in millimeters) of 39 specimens of *Mylodon harlani* are as follows: Greatest distance from radial surface to face for unciform, measured over dorsal surface, 54.3; greatest width across radial surface, 66.1; dorso-palmar diameter across unciform facet, 51.2.

CUNEIFORM.

The cuneiform (fig. 72, A to E) is a very compact bone with extensive, flattened proximal face devoted to articulation with the ulna. The dorsal surface (fig. 72 B) is much more extensive than the palmar (fig. 72 D) and is rugose, projecting well above the general dorsal plane of the carpus. Distally the cuneiform (fig. 72 C) decreases considerably in dorso-palmar diameter, and there is developed a prominent convexity articulating with the unciform. This surface, when continued toward the inner and palmar sides, becomes concave, and is confluent over a rounded ridge with a small convex facet on the inner side of the cuneiform (fig. 72 E) for the lunar. At the union of posterior and palmar borders the ulnar surface is continuous at a right angle, with a small convex facet for the pisiform (see fig. 72, A and D).

The average measurements (in millimeters) of 42 specimens of *Mylodon harlani* are as follows: Greatest distance across dorsal surface from inner to outer side, 68.4; greatest proximo-distal distance, measured normal to ulnar surface, 50.5; greatest dorso-palmar distance across ulnar articulating surface, 61.3.

PISIFORM.

The pisiform (fig. 73, A, B, C) of *Mylodon* is a heavy nodular bone. When viewed from the outer distal aspect (fig. 73 A) it is seen to be usually wide above and narrowing below. The surface thus viewed is convex, except along the border of the facet for the cuneiform, where a groove is developed, and in which are located a number of nutrient foramina. The surface on the opposite side of the pisiform (fig. 73 C) tends to be concave.

The concave articulating surface is usually subtriangular in shape, but the latter varies somewhat and the facet may be oval. That portion of the surface forming the base of the triangle is deflected slightly from the cuneiform articulation and joins with the ulna. This small deflection of surface is not always present in specimens from Rancho La Brea. Below the apex of the subtriangular facet and close to its margin the rugose surface of the pisiform frequently shows a small but deep and characteristic depression. The long axis of the element is oblique to the principal axis of the facet for the cuneiform.

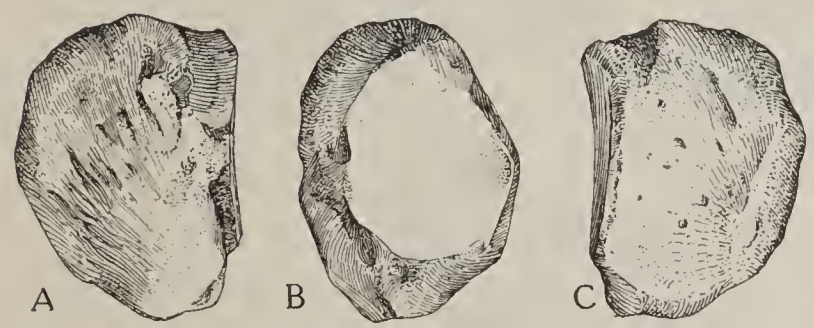


FIG. 73.—*Mylodon harlani* Owen. Right pisiform, No. 24261 U. C. C. *A*, outer distal view; *B*, view of surface for cuneiform; *C*, proximo-internal view. × 0.50. Rancho La Brea Pleistocene.

The average measurements (in millimeters) of 22 specimens of *Mylodon harlani* are as follows: Greatest length (*a* axis), 55.6; width, measured at right angles to *a* axis and below articulating facet (*b* axis), 34.7; depth measured from plane of cuneiform facet and normal to the *a* and *b* axes, 36.4.

UNCIFORM.

This element in *Mylodon* (fig. 74, A to E) differs mainly from the unciform of *Hapalops* in its method of articulation with the metapodial bones. This is expressed in dorsal aspect (fig. 74 A) by entire absence of a proximo-internal development of bone articulating distally with the lateral process of metacarpal III. In *Mylodon* the articulation between unciform and third metacarpal consists only of two facets, seen on the inner side (fig. 74 B), situated along the distal border and separated by an interarticular gutter. These facets are also usually separated from the surface for the magnum, lying along the proximal border of the inner side, by a rugose channel. The interarticular areas are perforated by a number of foramina. The dorsal facet for metacarpal III is always the smaller (not well shown in fig. 74 B, surface to the left), and may be often continuous proximally with the magnum facet, from which it is to be distinguished by a ridge. The palmar facet is but rarely connected with the magnum surface, such a confluence having been noted only in 2 of the 38 specimens of the right series. From the above it may be readily inferred that the articulating surface for the magnum varies considerably in shape. In *Nothrotherium* and *Megalonyx* the surface for metacarpal III is not interrupted in its extent from the dorsal to the palmar border. In *Nothrotherium*, and presumably in *Megalonyx*, there is no sharp indentation of the dorsal portion of the metacarpal surface with an articulating area lying on each arm of a right angle,

as in the unciform of *Hapalops*. Thus the articulation between the unciform and metacarpal III in *Mylodon* is much more simple than that in the megalonychids, and among the latter that in *Hapalops* is decidedly the most complex (see discussion under *Nothrotherium* and *Megalonyx*).

The articulating surface for metacarpal IV (fig. 74 E) is narrow and band-like, extending from the border of the dorsal facet for metacarpal III along the distal border of the dorsal surface for a short distance and thence to the palmar side, where it terminates at the border of the palmar facet for the third metacarpal. This surface is demarcated from the facets for metacarpal III by approximate right angles, in which respect it resembles that in the unciform of *Hapalops*, but the surface differs from the latter in being relatively less extensive. It preserves the sigmoid curvature in dorso-palmar direction which this surface possesses in *Hapalops*. Along its outer border it is continuous over a ridge, with the relatively broad surface for metacarpal V.

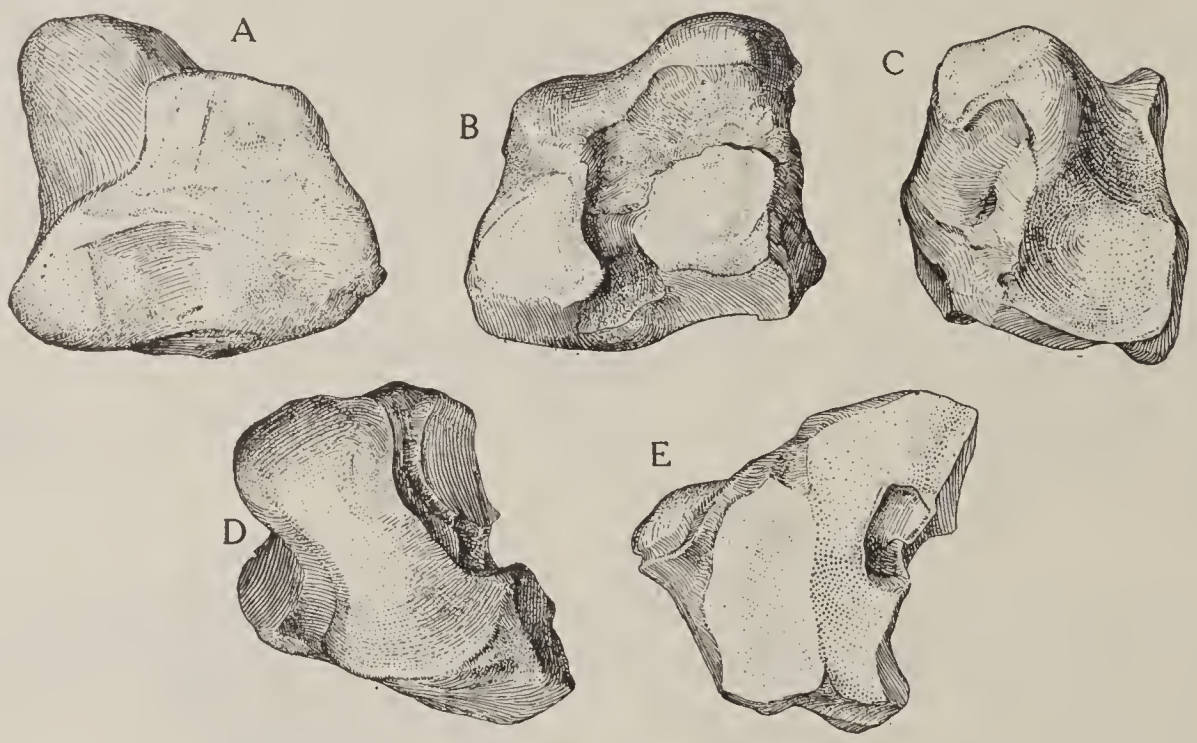


FIG. 74.—*Mylodon harlani* Owen. Right unciform, No. 24265 U. C. C. *A*, dorsal view; *B*, inner view; *C*, outer view showing surface for cuneiform; *D*, proximal view; *E*, distal view showing surfaces for metacarpals IV and V. × 0.50. Rancho La Brea Pleistocene.

The articulating surface for lunar and cuneiform forms a boss or knob (fig. 74 D) which is more prominent than in the unciform of *Megalonyx* or *Nothrotherium*. Along the inner border of the former surface is that for the magnum. The facet for the lunar is narrow and of sigmoid curvature. It differs from that in the unciform of megalonychids in being distinctly demarcated along the outer side from the surface for the cuneiform.

The average measurements (in millimeters) of 38 specimens of *Mylodon harlani* are as follows: Greatest transverse diameter across dorsal face, 69.4; proximo-distal diameter from tip of proximal boss to palmar half of surface for metacarpal IV, 58.8; dorso-palmar distance across surface for metacarpal IV, 57.4.

MAGNUM.

As remarked by Lull (1915, p. 369), the shape of this element (fig. 75, A to E) is very irregular, and there are a number of surfaces which articulate with those of the surrounding carpal bones. The facets do not always preserve their individuality, but their boundaries are often merged or confluent with those of neighboring facets.

The variation which occurs most frequently is the union of the dorsal and palmar facets situated on the distal side of the magnum and articulating with metacarpal III. The surface thus formed is expanded at the dorsal border and somewhat more so at the

palmar border, these areas being connected by a narrow band. It possesses a sigmoid curvature in dorso-palmar extent and the outline is sinuous. The dorsal portion of the surface is separated by a rugose interarticular area from a small facet (fig. 75 B), articulating also with the median metacarpal. The ventral expansion is continuous with, although demarcated by a right angle from, a small facet directed upward and articulating with metacarpal II (fig. 75 D, upper right facet). Along the dorsal border for about half its distance and on the inner side of the magnum (fig. 75 D, lower right facet) is a facet for the trapezoid, which lies confluent with, but demarcated by, a sharp angle from the usually smaller facet for the third metacarpal. The former facet may barely touch the proximal convex surface for the scaphoid (fig. 75 D, upper left facet) which extends to the palmar side.

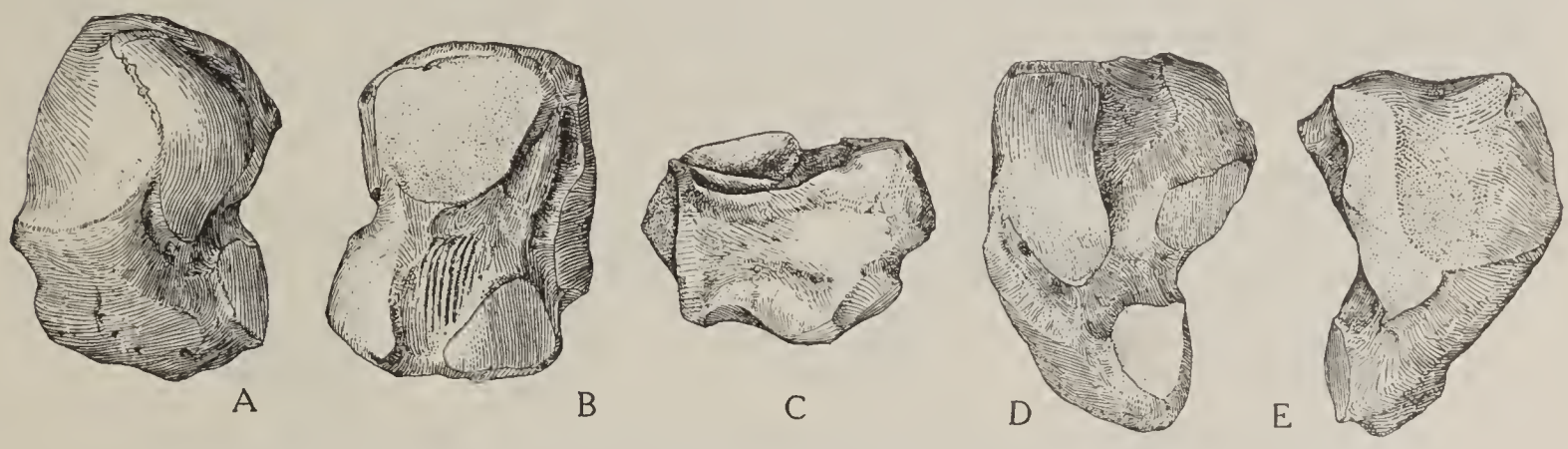


FIG. 75.—*Mylodon harlani* Owen. Right magnum, No. 24266 U. C. C. *A*, proximal view; *B*, distal view; *C*, dorsal view; *D*, inner view; *E*, outer view. × 0.50. Rancho La Brea Pleistocene.

All three facets—for scaphoid, trapezoid, and metacarpal III—are separated from the small facet for metacarpal II by an interarticular gutter which joins on the distal surface of the magnum with the space lying between the articulating facets for the median metacarpal. In *Megalonyx*, according to Leidy (1855, p. 31):

"On the outer[a] side it [the magnum] presents at the dorsal border a tripartite articular facet, separated by a deep interarticular groove from an oval facet at the palmar border. The tripartite facet articulates with the scaphotrapezial, the trapezoid, and median metacarpal bones; and the oval facet . . . . articulates with the trapezial portion of the scaphotrapezium."

TABLE 78.—*Variation in confluence of facets in 32 specimens (of right magnum).*

	Specimens.	Percentage.
Scaphoid facet with trapezoid facet	10	31.25
Unciform with dorsal facet on distal face for metacarpal III	12	37.5
Dorsal and palmar facets on distal face for metacarpal III	14	43.75
Palmar facet on distal face with dorso-internal facet, both for metacarpal III	2	6.25

In *Mylodon* there is but a single articulating surface for the scaphoid, while the small facet for metacarpal II is absent in the magnum of *Megalonyx*. In the latter the principal surface of the distal end (Leidy, fig. 13 A, plate 8) articulating with metacarpal III extends from the dorsal to the palmar border as in *Hapalops*. In *Mylodon* the corresponding surface is represented by two facets which are disconnected in over half the number of specimens examined of the right series. The articulating surface for the lunar (fig. 75 A, left facet), as indicated by Lull (1915, p. 369), is separated from that for the

[a] The designation outer and inner side as used by Leidy is not quite clear to the writer. The articulating surfaces for scaphoid and trapezoid lie certainly on the inner rather than on the outer side of the magnum of *Mylodon*. It is possible that Leidy considered the terms outer and inner with reference to a different orientation of the specimen than that held in the present text.

scaphoid by crest or faint groove. It is a large facet with sigmoid curvature and is bounded on the outer side by a narrow but long articulating surface (fig. 75 E) for the unciform. The latter varies considerably in shape.

The average measurements (in millimeters) of 32 specimens of *Mylodon harlani* are as follows: Greatest dorso-palmar distance, measured across distal surface, 64.5; width of dorsal surface, 44.5; proximo-distal diameter, 44.4; width across palmar surface, measured normal to unciform surface, 43.1.

TRAPEZOID.

The trapezoid (fig. 76, A to E) is the smallest element of the carpus. Viewed from the dorsal side (fig. 76 C), this bone is seen to be roughly triangular in shape. The largest facet possessed by the trapezoid is situated on the proximal side (fig. 76 A) where it articulates with the scaphoid. It is ovoid in shape and for the most part flattened, with the outer portion sharply deflected distally (fig. 76 D). On the dorsal surface this is expressed by an obtuse angle between the proximal and proximo-external borders.

FIG. 76.—*Mylodon harlani* Owen. Right trapezoid, No. 24267 U. C. C. *A*, proximal view; *B*, inner view showing below the facet for metacarpal II; *C*, dorsal view; *D*, outer view showing above deflected surface for scaphoid and below facet for magnum; *E*, distal view showing from left to right the facets for magnum, metacarpal III, metacarpal II. × 0.50. Rancho La Brea Pleistocene.

Distally the trapezoid joins the metacarpals by two facets and with the magnum by a single facet. A small facet articulating with the metacarpal III truncates the distal prominence, on the inner side of which is situated the surface for metacarpal II and on the outer side the facet for the magnum. The surface for the second metacarpal is relatively large, with principal axis in dorso-palmar direction, while that for the magnum is smaller, with principal axis more in a proximo-distal direction. The great dorso-palmar extent of the facet for the second metacarpal carries the lower surface of the trapezoid well below the inferior margin of the facet for the scaphoid (fig. 76 B). The extent of articulation between trapezoid and metacarpal III varies considerably in specimens from the asphalt beds.

The average measurements (in millimeters) of 21 specimens of *Mylodon harlani* are as follows: Greatest dorso-palmar diameter (*a* axis), 30.9; greatest distance from surface for scaphoid to surface for metacarpal III, measured across dorsal face (*b* axis), 34.6; greatest distance across dorsal face, measured approximately normal to *b* axis (*c* axis), 40.5.

From the average measurements, given above, it is seen that the length of the *c* axis is the greatest of the three measurements, while the *a* axis is the shortest and the *b* axis lies between these two in length. There are, however, a few specimens which do not conform to the average measurements. In No. 1489–R–7, for example, the *a* axis is greater than the *b* axis and slightly greater than the *c* axis, and No. 1489–L–1 has the *a* axis greater than the *b* axis, but distinctly less than the *c* axis. In No. 1489–R–7 the excessive length of the *a* axis is due to the great palmar extent of the facet for metacarpal II.

TRAPEZIUM AND METACARPAL I.

It has already been noted in the discussion of the scaphoid that the trapezium has not fused with this element, as Owen supposed, but that the trapezium has co-ossified with the first metacarpal. In *Mylodon* the right-angled element thus produced (fig. 77,

A to D) is very similar in shape to the articulated trapezium and metacarpal I in *Hapalops*. Winge (1915, p. 193) has noted the fusion of metacarpal I and trapezium in *Scelidotherium magnum*, but in the compound element thus formed (H. Winge, plate 39) the lateral process is not so prominent as in that of *Mylodon*. In the manus of *S. magnum* as shown by Winge, the trapezium-metacarpal I element articulates distinctly with the trapezoid; an articulation which is totally lacking in *M. harlani* and *M. robustus*.

Of interest in this discussion is the occurrence in the Rancho La Brea collection of several specimens in which the lateral process has ossified separately and has not fused with the principal shaft representing metacarpal I. This is well shown by the two specimens in figure 77, E to I, both of the left side, but not of the same individual. They have been placed in juxtaposition to indicate the relation of parts. The lateral piece possesses the usual articulating surface for metacarpal II. Internally and upon the proximal face is a small facet for the scaphoid, which is a continuation of the surface for the same element situated on the inner piece. Since in earlier forms the trapezium

FIG. 77.—*Mylodon harlani* Owen. *A* to *D*, right metacarpal I and trapezium, No. 24268 U. C. C. *A*, dorsal view; *B*, proximal view; *C*, outer view showing on left a small facet for metacarpal II; *D*, distal view showing on right surface for digit I and on left the distal portion of facet for metacarpal II. × 0.50. *E*, left metacarpal I, No. 1482–L–21, dorsal vew; *F*, trapezial moiety, dorsal view; *G*, trapezial moicty showing contact surface for metacarpal II; *H*, metacarpal I, No. 1482–R–11, dorsal view; *I*, No. 1482–R–11, inner view showing facet for trapezial moiety. × 0.50. Rancho La Brea Pleistocene.

and metacarpal I arose from separate centers of ossification, we may expect to find these centers occasionally remaining distinct in *Mylodon* and giving rise to two independent elements in the mature individual. Perhaps in such instances the lateral piece is the homologue of the trapezium and the medial piece the homologue of the first metacarpal. It is to be noted, however, that in *Hapalops* the articulation exists between scaphoid and trapezium, whereas in the present case a portion of the scaphoid surface is borne by the medial piece and the remaining portion by the lateral piece.

The separation of the metacarpal I trapezial element in *Mylodon harlani* into two distinct parts is known to occur 3 times in the left series of 27 specimens and once in the right series of 21 specimens. Since each of these occurrences is known from a different pit at Rancho La Brea, it is safe to assume that at least 4 individuals were characterized by the division of the compound element.

When the element formed by the union of trapezium and metacarpal I is viewed in dorsal aspect (fig. 77 A) it is seen to consist of two arms which meet in a right angle. The principal shaft is well developed, notwithstanding its shortness, and articulates at the proximal end (fig. 77 B) with the process of the scaphoid by an ovoid facet whose long axis is transverse. At the distal end articulation with the digit is formed by an

oval convexity with flattened base (fig. 77 D). The main axis of this surface is oblique. A small portion of the articulating surface continues upon the palmar side and occasionally the middle of the palmar border is notched.

As remarked, the lateral arm meets the main shaft in a right angle, but when the metapodial is viewed from the proximal end (fig. 77 B) the former is seen to rise obliquely upward to its articulation with the second metacarpal. This articulation consists of a small facet (fig. 77 C) directed laterally, with a portion of the surface curving well to the distal side (fig. 77 D). With the exception of the articulating facets, the surface of the element is highly rugose and pierced by a number of nutrient foramina.

The average measurements (in millimeters) of 21 specimens are as follows: Proximodistal diameter of shaft measured normal to plane of facet for scaphoid, 39.8; greatest distance between inner side of shaft and end of lateral process, 45.8.

CO-OSSIFIED PHALANGES I AND II, DIGIT I, MANUS.

The first and second phalanges of digit I are fused in the manus of *Mylodon*, forming an element (fig. 78, A to D) somewhat similar to that of the second digit of the pes. In the manus, the element is distinctly smaller and more slender than that in the pes. The proximal end (fig. 78 A) is oval in shape, with flattened base, and conforms with the surface on metacarpal I, with which it joins. A principal axis extending through the middle

FIG. 78.—*Mylodon harlani* Owen. Co-ossified phalanges I and II, digit I, right manus, No. 24269. U. C. C. *A*, proximal view; *B*, outer view; *C*, dorsal view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

of the proximal articulating face in dorso-palmar direction is oblique to the median vertical plane of the phalanx. This suggests a convenient method of distinguishing right from left element, as follows: Orient the phalangeal segment in proximal view with palmar border horizontal. The principal oblique axis of the proximal surface lies to the left or to the right of an axis normal to the base, according to whether the element belongs to the left or right manus, respectively.

At the distal extremity (fig. 78 D) the articulating surface is directed mainly forward and downward. It is unevenly divided by a furrow into inner and outer portions, of which the former is distinctly the larger and extends farther upon the palmar surface. The inner portion forms a complete convex curve, whereas the outer forms but half of such a curve. In the phalanx of the pes such a complete convex surface is never developed.

The average measurements (in millimeters) of 19 specimens of *Mylodon harlani* are as follows: Total length, 34; depth of proximal end measured normal to base, 28.7; width of proximal end, 21.5; greatest transverse width behind distal articulation, 21.2.

PHALANX III, DIGIT I, MANUS.

The terminal phalanx of the first digit, manus (fig. 79 A, B, C), is the smallest of the ungual series, being smaller and not so heavy as the ungual phalanx of digit II, pes. Considerable variation is shown in the form of the proximal articulating surface. The usual type consists of an inner large and an outer small area continuous over a low vertical ridge, with the posteriorly projecting proximal end situated mainly over the inner area. In some specimens the two articulating surfaces may be of approximately equal size, with the ridge median in position. In other specimens (No. 1471–L–6, for example) the ridge tends to disappear, and a single concave surface articulates with the proximal element.

The base of the phalanx is flattened near the proximal articulation, but becomes tuberous toward the distal end. On each side of the subungual tubercle are two foramina, which lie in the same general depression. The lowermost one on each side penetrates the base, while the foramen above and behind the latter permits the entrance of vessels which supply the base of the nail. On the outer side of the phalanx the foramen piercing the sheath lies farther above the foramen in the base than it does on the inner side, and causes this side of the sheath to be more extensively scarred. The sides of the claw-process indicate the path taken by the vessels which penetrate the sheath. This path on the inner side extends forward and upward to the rugose area at the free end of the process, where it bifurcates. The claw-process is asymmetric, for the greater portion of the dorsal convex surface lies to the inner side of a vertical plane passing through the process, and the separation between the palmar convex surface of the process and the lateral wall is lower on the inner side than on the outer side.

Allen describes the corresponding element in *Mylodon garmani* as follows (p. 336):

"The first ungual phalanx . . . . measures 90 mm. in extreme length and differs from the others in having a stem some 25 mm. in length, the long axis of which is bent at an angle with that of the claw-bearing portion. This angle seems much greater than in *M. robustus*. The proximal face is slightly concave. The bony core of the claw is some 55 mm. long, laterally compressed, and regularly tapering in side view to a blunt point. The basal half is surrounded by a thin bony sheath which becomes much thickened and rugose at the base ventrally . . . . ."

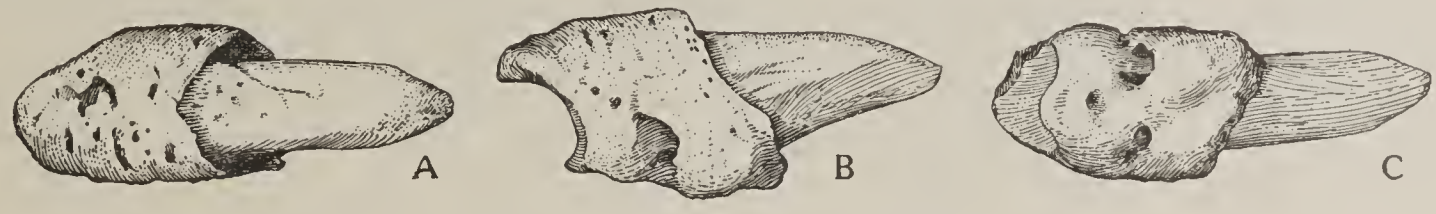


FIG. 79.—*Mylodon harlani* Owen. Ungual phalanx, digit I, right manus, No. 1471–R–1. *A*, dorsal view; *B*, outer view; *C*, ventral view. × 0.50. Rancho La Brea Pleistocene.

A comparison between the Rancho La Brea specimens and the figure of Allen's specimen (Allen, 1913, plate 3, fig. 10) discloses the fact that the "stem" of the first ungual phalanx is in reality the co-ossified first and second phalanges, and this compound structure has in turn been fused with the ungual phalanx, so that the entire digit is here represented. It is worthy of note that among all the material of *Mylodon harlani* from the asphalt beds a comparable fusion has not been found.

The average measurements (in millimeters) of 23 specimens of *Mylodon harlani* are as follows: Greatest length, measured from most projecting part of proximal end to distal end of claw-process, 74.8; depth at proximal end, 28.7; distance from subungual tuberosity to dorsal surface of claw-process, measured normal to dorsal border, 32.1; greatest width at proximal end, 28.9; width of claw-process at distal end of subungual tubercle, 15.8.

METACARPAL II.

This metapodial (fig. 80, A to E) is, next to metacarpal I, the smallest of the metacarpal series. The proximal extremity (fig. 80 D) is of triangular shape and bears an articulating surface for the trapezoid. The latter is usually narrow and lies along the lateral border, where it is confluent with, but demarcated by, a sharp angle from the articulating concavity for metacarpal III on the outer side. In No. 1488–R–29 the surface for the trapezoid is quite extensive and reaches across the proximal extremity to its inner border. The apex of the triangular-shaped proximal end is truncated obliquely by a small facet which articulates with the magnum. The distal extremity (fig. 80 E) is modified to form a strong articulation for a well-developed digit, and this surface encroaches well upon the dorsal side of the metapodial (fig. 80 B), permitting a strong retraction of the digital elements. The carina is prominent, rounded above, but

becoming sharper below, and is oblique with reference to a median plane passing through the metapodial, the lower end lying on the inner side of such a plane. On each side of the carina is an offset articulating also with the first phalanx. The offset on the inner or radial side of the carina is broad above and continues to the palmar side with about the same width, while that on the outer or ulnar side increases from little or nothing to a considerable width below. Both inner and outer offsets articulated below with sesamoids.

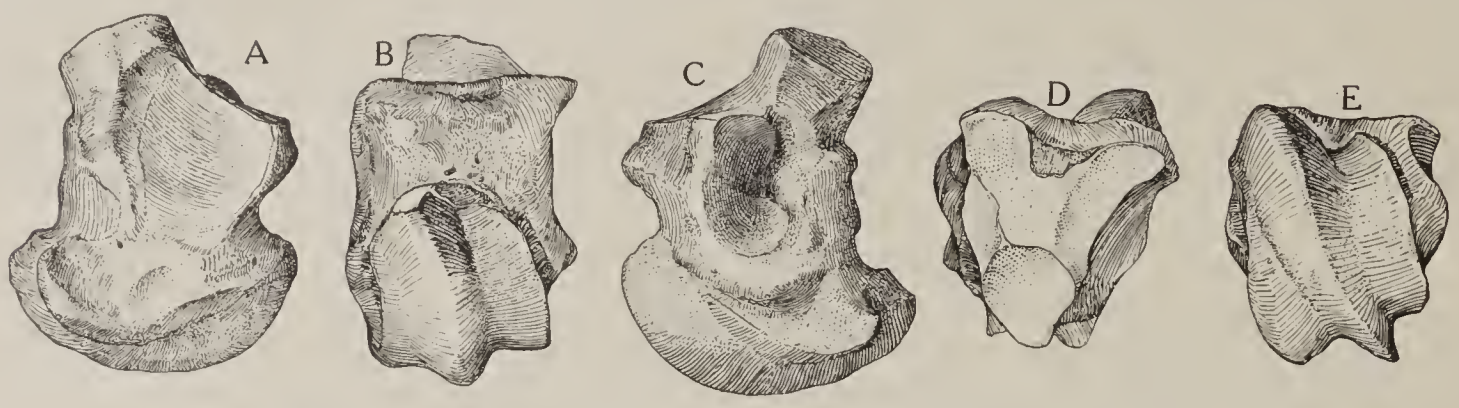


FIG. 80.—*Mylodon harlani* Owen. Right metacarpal II, No. 24270 U. C. C. *A*, outer view; *B*, dorsal view; *C*, inner view; *D*, proximal view; *E*, distal view. × 0.50. Rancho La Brea Pleistocene.

At the proximo-dorsal angle of the inner side of the metapodial (fig. 80 C) is an elongate, concave articulating surface for metacarpal I. On the opposite side (fig. 80 A) is a larger concavity articulating with the third metacarpal.

The average measurements (in millimeters) of 27 specimens of *Mylodon harlani* are as follows: Greatest length, 71.6; greatest diameter of distal carina, 51.4; depth of shaft, 35.1; width of distal articulating surface, 33.7.

PHALANX I, DIGIT II, MANUS.

This element (fig. 81 A, B, C) is nearly as broad at the base as it is high. It is much shortened proximo-distally, and in this direction the inner side (fig. 81 B) is longer than the outer. The proximal extremity (fig. 81 A) is devoted entirely to articulation with metacarpal II, and consists principally of a median groove which narrows below. Along the inner border the furrow is flanked for the greater part of its extent by an articulating offset for the metapodial which tends to incline away from the groove. Along approximately the lower half of the opposite border of the groove is also an offset, but this one, in contrast to the inner offset, lies horizontal. In palmar view it is to be noted that the angle between the inner offset and the inner face of the median groove approaches more nearly a right angle than does the angle between the outer offset and the outer face of the groove. This is due in part to a more steeply inclined inner surface of the furrow

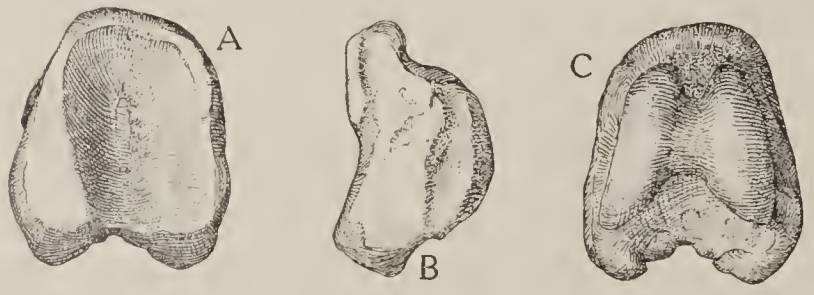


FIG 81.—*Mylodon harlani* Owen. Phalanx I, digit II, right manus, No. 24271 U. C. C. *A*, proximal view; *B*, inner view; *C*, distal view. × 0.50. Rancho La Brea Pleistocene.

when contrast is made with the outer surface. Both offsets are continued below by small facets which articulate with sesamoid bones. On the distal extremity (fig. 81 C) articulation with phalanx II is accomplished by an inner and outer convexity separated by a median groove. The outer convexity or condyle is of greater dorso-palmar extent than the inner condyle. These distal convex surfaces readily distinguish the phalanx from the corresponding element of digit III, pes, in which the condyles are flatter. The palmar border of the phalanx below the distal articulation is notched.

The average measurements (in millimeters) of 34 specimens of *Mylodon harlani* are as follows: Greatest depth, 49.1; greatest width, 41.5; proximo-distal diameter across inner side, 27.4.

PHALANX II, DIGIT II, MANUS.

This is a powerful phalangeal segment (fig. 82, A to D) suitable to support a well-developed ungual phalanx. The proximal extremity (fig. 82 C) is elongated in dorso-palmar axis, narrowing above and with flattened base below. It supports two concave facets separated in middle line by a tumid ridge which widens below, separating the facets farthest in this region. The distal extremity (fig. 82 B) is modified to form a trochlea, the outer condyle of which is the larger and is separated from the inner condyle by a broad groove. This groove is broader and in most instances more shallow than in second phalanges of *Megalonyx*. It terminates dorsally in a deep pit for reception of the posteriorly projecting process of the ungual phalanx. The circumference of the inner condyle describes two-thirds of a circle. At the postero-dorsal angle of the outer surfaces of the condyles heavy overhanging ridges are developed, indicating strong tendinous attachments. The shaft of the phalanx is deepest as measured over the outer surface.

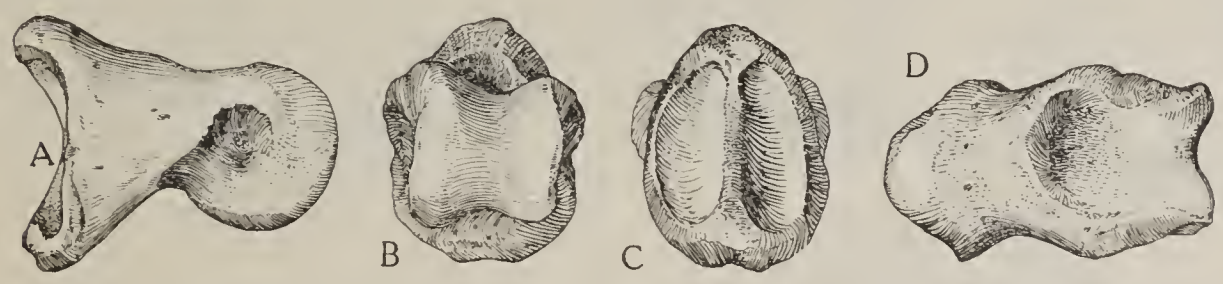


FIG. 82.—*Mylodon harlani* Owen. Phalanx II, digit II, right manus, No. 24272 U. C. C. *A*, outer view; *B*, distal view; *C*, proximal view; *D*, dorsal view. × 0.50. Rancho La Brea Pleistocene.

The average measurements (in millimeters) of 30 specimens of *Mylodon harlani* are as follows: Greatest length measured through middle, 54.1; depth of proximal end, 47; depth of outer condyle, 34.1; width of proximal end, 36.8; greatest width across posterior region of distal trochlea, 36.

PHALANX III, DIGIT II, MANUS.

Next to the ungual phalanx of the median digit of the manus, this element (fig. 83, A, B, C) is the largest of the terminal series. The proximal articulation consists of two concave surfaces, continuous over a median low and broad ridge, of which the outer is, of course, the larger one. Both facets are continued upward along the under surface of the posterior projection. About one-half of the basal length of the phalanx is devoted to the base of the claw-process, and from which arises the bony sheath that encases the posterior portion of the claw. The base is flattened, with discoid area roughly outlined distally, behind which and on each side of the base are located the foramina for the subungual vessels. The inner foramen is larger than the outer one and is often divided into two by a bony partition. The bony sheath, although well developed along the sides of the claw-process, becomes thin above, and hence is rarely preserved entire in specimens from Rancho La Brea. It is doubtful, too, whether the sheath was always developed over the dorsal surface of the claw. The claw-process is convex dorsally, but the curvature is not symmetric with reference to a median vertical plane. Toward the tip the upper surface is marked by a sharp angle from the sides. The border marking the separation between palmar and lateral surfaces is lower on the inner side than on the outer side.

No. 1470–R–1 and No. 1470–R–25 represent the extremes in size of the ungual series of the second digit. Another interesting comparison can be made between specimens 1470–R–19 and 1470–R–3, which indicate the extremes in thickness of claw-

process. The former is one of the most slender of ungual phalanges for digit II which has been examined, while the latter is one of the heaviest. In the left series of terminal phalanges, No. 1470–L–24 exceeds even No. 1470–R–3 in thickness of claw-process, the *f* axis (see below) in this specimen measuring 35.7 mm.

TABLE 79.—*Average measurements (in millimeters) of 21 specimens of Mylodon harlani.*

Greatest length, measured from most projecting portion of proximal end to end of claw-process (*a* axis)	153.6
Distance from proximal end of subungual base to end of claw-process (*b* axis)	125.6
Greatest proximo-distal diameter of subungual base (*c* axis)	61.8
Depth of proximal end (*d* axis)	43.9
Width of proximal end (*e* axis)	46.2
Greatest transverse width of claw-process at distal end of subungual base (*f* axis)	28.1

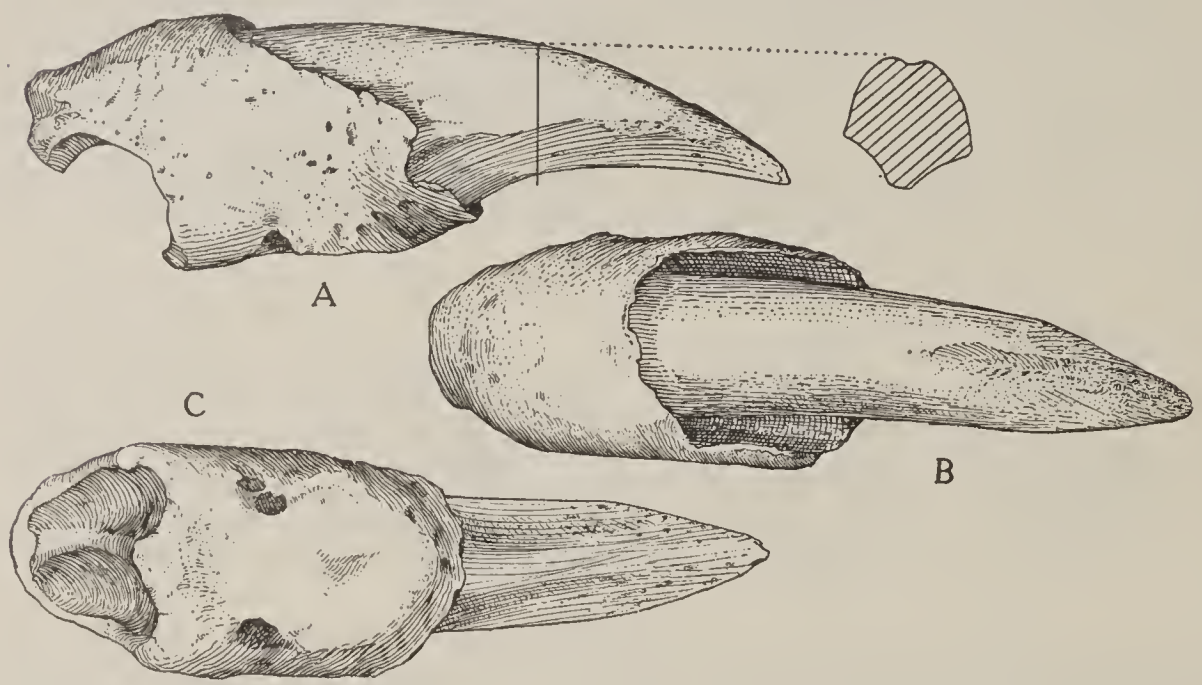


FIG. 83.—*Mylodon harlani* Owen. Ungual phalanx, digit II, right manus, No. 24273 U. C. C. *A*, outer view with cross-section of claw-process; *B*, dorsal view; *C*, ventral view. × 0.50. Rancho La Brea Pleistocene.

METACARPAL III.

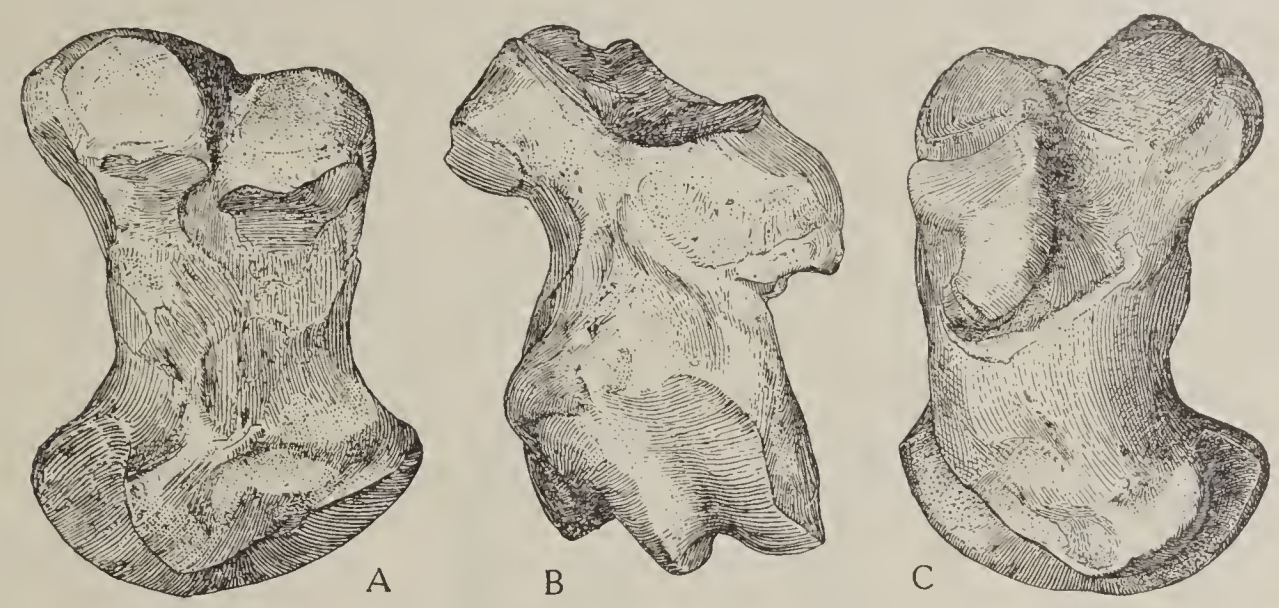
Metacarpal III (fig. 84, A to F) is the stoutest of the metacarpal series, preserving the heaviness which characterizes this metapodial in the earlier ground-sloths. The shaft is nearly quadrate in section, with both the proximal and distal extremities greatly modified to articulate with adjoining elements. The proximal border of the dorsal surface is indented and marks the separation between inner and outer processes of the proximal end. This extremity (fig. 84, D and F) may be divided into three parts, of which the lateral processes form two and the ventral or palmar projection the third division.

TABLE 80.—*Measurements (in millimeters) of extremes of ungual series in digit II, manus.*

	a axis.	*b* axis.	*c* axis.	*d* axis.	*e* axis.	*f* axis.
1470–R–1	170.4	142.9	67.5	45	48.5	29.3
1470–R–25	139	116	52.1	39.4	41.8	25.6
1470–R–19	148.9	123.5	60.3	41.6	42.8	25.2
1470–R–3	157.7	127.8	63.2	48.8	52.6	33.6

Close to the middle of the dorsal border a pit is developed on the proximal surface which separates the two dorsal facets for the magnum. The outer of the two facets forms the inner proximal surface of the lateral process. It forms a right angle with an articulating surface on the outer proximal side of the process for the unciform. This facet, in turn, is separated by a right angle from an articulating surface on the outer distal side of the process for metacarpal IV. In other words, the lateral process is

sharply defined on three sides by articulating facets. The inner process supports mainly an articulating convexity for metacarpal II (fig. 84 c). Between this surface and the inner dorsal facet for the magnum lies the facet for the trapezoid. The palmar division of the proximal extremity supports along its inner lower border a large facet, also for the magnum. Its outer side supports two facets meeting in a sharp angle, one directed proximally, the other, which is small, directed distally. The former facet is for the unciform, the latter for the fourth metacarpal. The palmar portion of the proximal end supporting the two facets is separated from the lateral process by a deep groove.



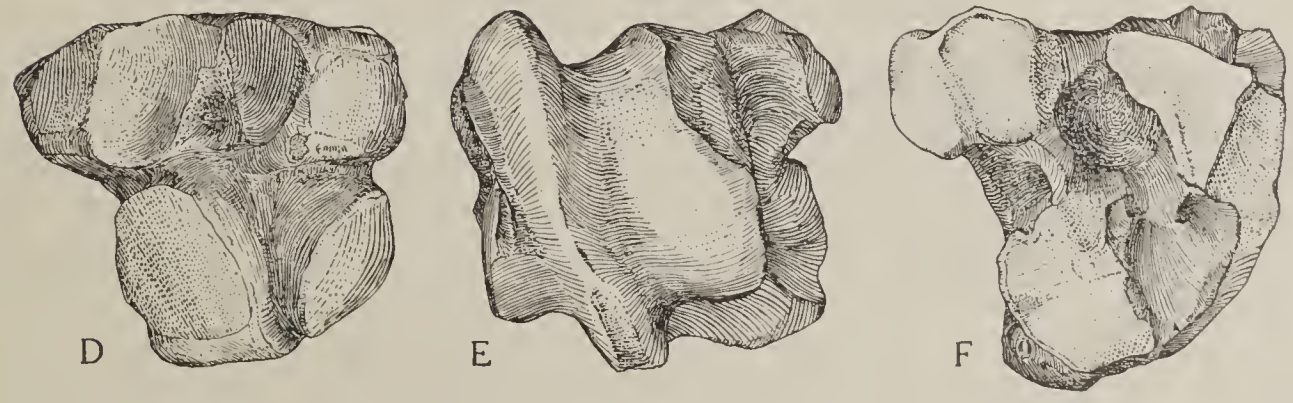


FIG. 84.—*Mylodon harlani* Owen. Right metacarpal III, No. 24274 U. C. C. *A*, outer view; *B*, dorsal view; *C*, inner view; *D*, proximal view; *E*, distal view; *F*, proximal view of another specimen, No. 23148 U. C. C., showing confluence of facets. × 0.50. Rancho La Brea Pleistocene.

As may be inferred from the description of the magnum, the outer dorsal facet and the palmar facet, both of which articulate with this element, are frequently confluent in metacarpal III. This is shown in figure 84 F.

TABLE 81.—*Average measurements (in millimeters) of 30 specimens of metacarpal III of Mylodon harlani.*

Greatest length	103.1
Greatest depth of shaft across outer surface	38.3
Greatest extent of carina	69.8
Greatest width of proximal end	75.5
Least width of shaft, measured across dorsal surface	42.6
Greatest width of distal end	50.9
Depth of proximal end, measured across proximal surface	66

The distal extremity (fig. 84 E) resembles that of metacarpal II and allows a very free and easy rotation of the median digit. The articulation encroaches well upon the dorsal surface. The great carina is relatively not as broad above as that of the second

metacarpal, and extends obliquely downward and inward from the upper surface to form the pronounced ridge between the surfaces for the sesamoids. This obliqueness does not characterize the carina of metacarpal III in earlier types of ground-sloths. On its inner side is a very broad articulating offset for the first phalanx, while along the outer side this offset becomes perceptible only near the sesamoid surface.

SESAMOID BONES FOR METACARPAL III.

These elements are shown on plate 35, figure 2. The inner sesamoid is a broad element, being compressed in dorso-palmar direction, with development of a prominent flange extending downward along the entire inner side. This causes the palmar surface to be broadly and deeply concave. The opposite face of the bone bears an articulating facet for the inner offset of metacarpal III. This surface is longer than wide and is concave. It is continuous with but demarcated by a right angle from an elongated lateral facet articulating with the side of the carina of the metapodial. Dorsally the facet for the offset is continued at a right angle with a narrow, transversely elongated facet which articulates with the inner base of the first phalanx. In some specimens the extent of the latter facet may be quite small.

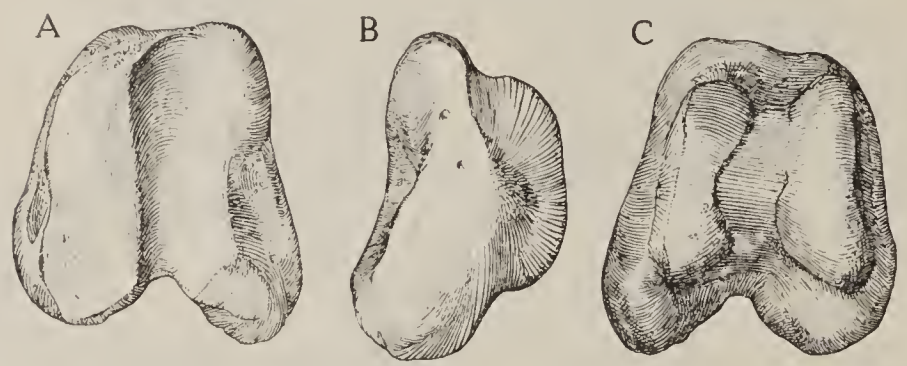


FIG. 85.—*Mylodon harlani* Owen. Phalanx I, digit III, right manus, No. 24275 U. C. C.; *A*, proximal view; *B*, outer view; *C*, distal view. × 0.50. Rancho La Brea Pleistocene.

The outer sesamoid differs entirely in shape from the inner sesamoid. It is a heavier element than the latter; what it loses in transverse width it compensates in dorso-palmar diameter. The inner surface of the sesamoid is concave between the facet for the outer wall of the carina and the lower border of the bone. The inner articulating surface is slightly concave in its long axis and rounds dorsally into an articulating surface for the outer offset of the metapodial. In contrast to the inner sesamoid, this surface in the sesamoid of the outer side is of smaller extent than the articulating surface for the side of the carina. Above the inner articulation and separated from it by a sharp angle is a broad, flat facet which joins with the outer base of the first phalanx. The two facets may often be continuous, and the latter shows considerable variation in shape. It is much broader in proximo-distal direction than the corresponding facet of the inner sesamoid.

The average measurements (in millimeters) of 24 specimens of inner sesamoid of *Mylodon harlani* are as follows: Greatest length, 46; greatest width, 29.9.

The average measurements (in millimeters) of 19 specimens of outer sesamoid of *Mylodon harlani* are as follows: Greatest length, measured parallel to dorsal surface, 47.4; width through middle, 20.2; greatest depth, 32.8.

PHALANX I, DIGIT III, MANUS.

The depth of this phalanx (fig. 85, A, B, C) exceeds slightly the greatest width. It is foreshortened in proximo-distal direction, as is characteristic of all the first phalangeal elements. The proximal end (fig. 85 A) is traversed by a deep median groove which extends the entire dorso-palmar depth and narrows below, permitting the phalanx to articulate snugly with the metapodial. Along the inner side of the groove is a flattened or concave surface conforming in outline to the surface on the inner side of the distal

carina of metacarpal III, with which it articulates. Below this surface and continued with it at a sharp angle is a small facet for a sesamoid bone. On the outer side of the median groove an extensive articulating surface is lacking. On the palmar side, however, there is a facet for a sesamoid bone which is larger than that of the opposite side.

The distal articulation (fig. 85 c) consists of two flattened condyles separated by a broad groove. The inner one is convex transversely, and is of greater dorso-palmar extent than the outer condyle. The median groove may be rugose, and this roughened area may encroach upon the surface of the outer condyle. The distal extremity apparently indicates but little movement between the first and second phalanges. The phalanx is of greatest proximo-distal extent as measured over the outer surface (fig. 85 B).

The average measurements (in millimeters) of 40 specimens of *Mylodon harlani* are as follows: Greatest depth, 62.7; greatest width, 58; proximo-distal diameter across outer surface, 39.6.

FIG. 86.—*Mylodon harlani* Owen. Phalanx II, digit III, right manus, No. 24276 U. C. C. *A*, proximal view; *B*, dorsal view; *C*, outer view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

PHALANX II, DIGIT III, MANUS.

Although this element (fig. 86, A to D) is directly comparable in length to the corresponding phalanx in the second digit of the manus, it greatly exceeds the latter in stoutness. The proximal extremity (fig. 86 A) is greatly elongated in dorso-palmar direction, with dorsal and palmar sides flattened and lateral borders convex. The two articulating facets are separated by a thick and low median ridge, and the inner facet is concave. At the distal extremity (fig. 86 D) the outer condyle of the trochlea is the larger, possessing a greater dorso-palmar diameter than the inner condyle. The median groove separating the two condyles is deep. The circumference of the outer condyle describes a half circle, while that of the inner condyle describes approximately two-thirds of a circle. The articulating surface of the latter condyle extends upon the inner side of the distal trochlea. Although the outer side of the phalanx (fig. 86 C) is deeper than the inner side, it is not so long in a proximo-distal direction as the latter.

The average measurements (in millimeters) of 42 specimens of *Mylodon harlani* are as follows: Length measured across middle of inner side, 48.9; greatest depth of inner condyle, 39.9; depth of proximal end, 57.8; greatest width of proximal end, 47.9.

PHALANX III, DIGIT III, MANUS.

Viewed from the outer side (fig. 87 A), the proximal articulation of the phalanx is seen to describe a semicircle, with the dorsal portion of the element projecting far backward. The proximal surface of this projecting portion is deeply indented. The inner of the two articulating surfaces is deeply concave, of smaller dorso-palmar extent than the outer, and is well inclosed along the inner side. In this phalanx the principal axis of the proximal articulation is oblique to the median vertical plane passing through the element, and the upper end of the axis lies to the outside of the plane, whereas in the terminal segment of the second digit, manus, this axis is vertical.

The base of the claw-process is similar to that of the ungual phalanx, digit II, manus, with the distal discoid area more prominently developed than in the latter. This area (fig. 87 c) is situated closer to the inner than to the outer border of the base. Immediately behind the area and on each side of the base are the two subungual foramina. The inner of these is much the larger and is often divided into two by a bony partition. Probing the openings thus formed indicates that the lateral one leads into the space between bony sheath and claw-process, while the medial one permits an entrance into the base of the claw-process. The bony sheath which incases the claw-process, but is well separated from its sides, arises from the base. In specimens from Rancho La Brea the sheath is preserved in various stages of completeness, and a number of ungual phalanges are present in which it is still intact over the top, reaching forward some 60 mm. from the proximal end. The sheath is often incompletely fused with the proximal end along the dorsal margin.

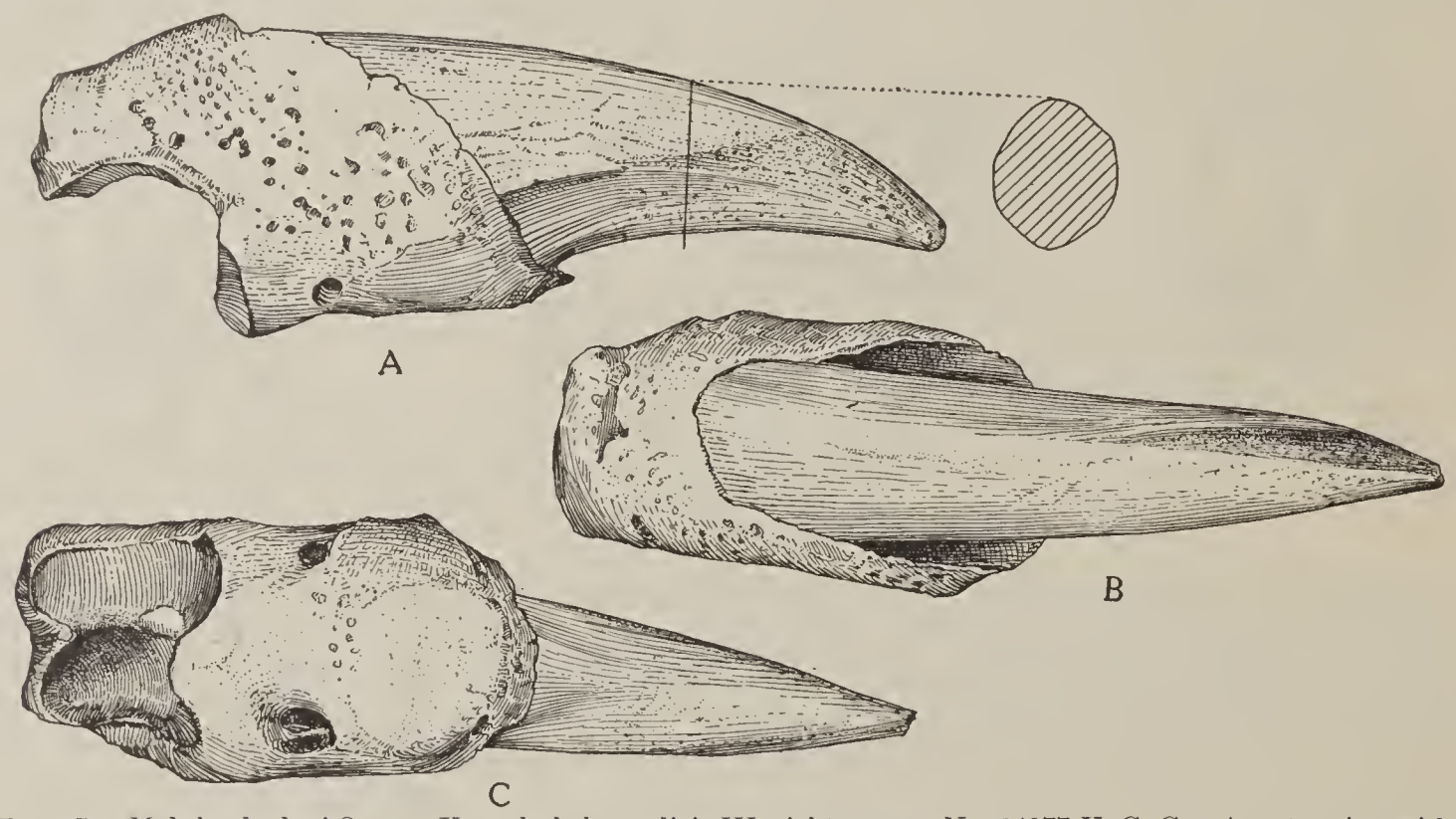


FIG. 87.—*Mylodon harlani* Owen. Ungual phalanx, digit III, right manus, No. 24277 U. C. C. *A*, outer view with cross-section of claw-process; *B*, dorsal view; *C*, ventral view. × 0.50. Rancho La Brea Pleistocene.

The claw-process is higher and relatively more narrow transversely than that in the terminal phalanx of digit II, manus. The palmar portion of the process not incased is more prominently convex than that of the latter phalanx. For a distance of approximately 70 mm. from the free end of the phalanx the dorsal surface of the claw-process is grooved (fig. 87 B) and the surface of this groove is directed toward the inner side. The free end of the process reaches a level indicated by the horizontal plane of the subungual base. Sometimes it extends slightly below this level.

TABLE 82.—*Average measurements (in millimeters) of 16 specimens of ungual phalanx, digit III, manus, of Mylodon harlani.*

Greatest length, measured from most projecting portion of proximal end to end of claw-process.	174.1
Distance from proximal end of subungual base to end of claw-process	141.2
Greatest proximo-distal diameter of subungual base	73.5
Vertical dorso-palmar distance between discoid area to dorsal surface of claw-process	57.2
Width of proximal end	55
Transverse width of claw-process at distal end of subungual base	31.3

METACARPAL IV.

This strongly developed metacarpal (fig. 88, A to E) is the longest of the anterior metapodial series, although not as heavy as metacarpal III. The proximal and distal extremities are quite heavy and the middle portion of the shaft may become relatively

slender. The outer or ulnar side of the metapodial is longer than the inner or radial side, due to the oblique truncation of the proximal end. The latter extremity is triangular in shape (fig. 88 D), and along the outer side is devoted to articulation with the unciform. This surface extends practically the entire dorso-palmar depth of the bone, and in this direction has a sigmoid curvature. It extends internally along the dorsal border and touches the usually concave facet for the third metacarpal. In such specimens the two articulating surfaces are distinguished by an intervening ridge. In other metapodials, however, the two are merged at this point. Along the palmar border a small facet is demarcated by an obtuse angle from the surface for the unciform and articulates also with metacarpal III. A narrow facet on the outer side of metacarpal IV (fig. 88 C) and articulating with the fifth metapodial is continuous with but demarcated by a sharp angle from the surface for the unciform.

FIG. 88.—*Mylodon harlani* Owen. Right metacarpal IV, No. 24278 U. C. C. *A*, inner view; *B*, dorsal view; *C*, outer view; *D*, proximal view; *E*, distal view. × 0.50. Rancho La Brea Pleistocene.

At the distal end (fig. 88 E) a prominent carina is not developed and the articulating surface indicates the reduced and functionless fourth digit. A narrow, convex articulating surface is present, which is elongated in dorso-palmar axis and bears a small offset, also for the first digital element, along its inner side. Below the distal convexity a prominent ridge is present and separates the two surfaces for the sesamoids. The outer of these surfaces is the larger one. The metapodial develops a large tuberosity to the outer dorsal side of the distal articulation. The latter surface is directed well to the inner side, which causes the rudimentary toe to assume a position far to the inner side of a median vertical plane through the metapodial.

TABLE 83.—*Average measurements (in millimeters) of 30 specimens of metacarpal IV of Mylodon harlani.*

Length	121.4
Dorso-palmar depth of proximal extremity, measured along outer side	62.3
Least depth of shaft	33.8
Greatest extent of distal articulation	59.3
Width of proximal end, measured normal to lateral surface	47.2
Least width of shaft	30
Greatest width of distal extremity	49.4

SESAMOID BONES FOR METACARPAL IV.

Because of the resemblance which exists between the distal extremities of metacarpal IV and metatarsal IV, there is also some similarity between the sesamoid bones which articulate with the metapodials. The outer element is broader than the inner,

as is also true of the sesamoids articulating with metatarsal IV. The outer sesamoid bone (fig. 89, A, B, C) differs from the corresponding element of the latter metatarsal in the distinct deflection of a portion of the articulating surface for the metapodial upon the outer side of the sesamoid. This is due to the presence in the anterior metapodial of a more defined or ridge-like outer border to the surface for the sesamoid, as contrasted with the fourth metatarsal. The outer sesamoid and the inner lack entirely the small dorsal facet which in the posterior sesamoids indicate an articulation with the first phalanx of the fourth digit. This absence is to be associated with the lack of any specimens in the collections of phalanx I, digit IV, manus, that have fused with sesamoid bones—a fusion which is known to occur in the pes.

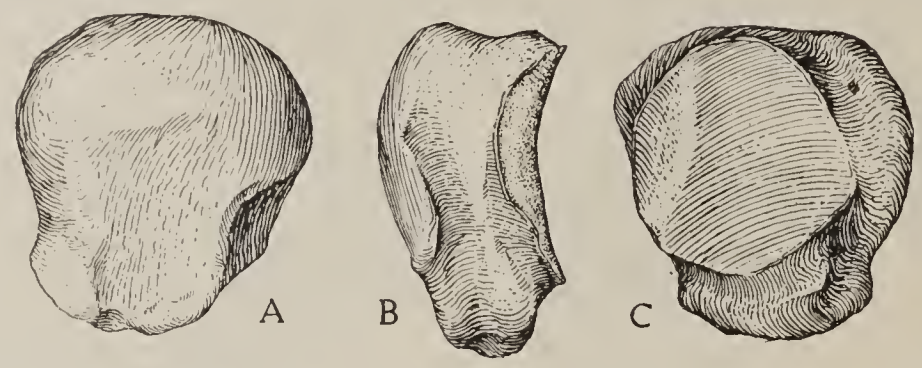


FIG. 89.—*Mylodon harlani* Owen. *A*, *B*, and *C*, outer sesamoid, metacarpal IV, left manus, No. 1462–L–4. × 1.0. Rancho La Brea Pleistocene.

The inner sesamoid bone (fig. 90, A, B, C), although approximating in size the corresponding element articulating with metatarsal IV, is noticeably thicker. It differs from the latter also in the more extensive articulating surface, not restricted to the dorsal half of the element. The portion of the surface articulating with the side of the ridge in the metapodial separating the two sesamoid bones is more extensive in dorsopalmar direction than that touching the surface at the side of the ridge.

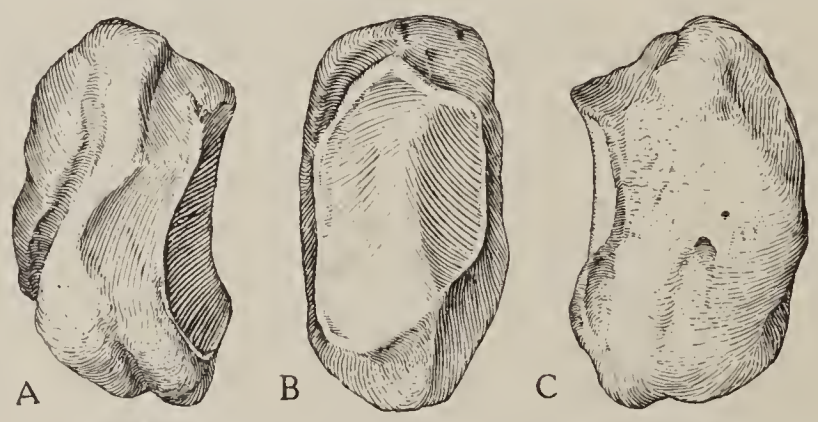


FIG. 90.—*Mylodon harlani* Owen. *A*, *B*, and *C*, inner sesamoid, metacarpal IV, left manus, No. 1468–L–5. × 1.0. Rancho La Brea Pleistocene.

PHALANX I, DIGIT IV, MANUS.

The first phalanx of the fourth digit (fig. 91, A, B, C) is peculiarly twisted out of the regular shape, as is shown by the fact that the median vertical plane is not normal to the plane of the proximal end, but forms an acute angle with that plane. When the phalanx is viewed from the proximal end, the principal axis of the latter face is not normal to the base, but joins it to form an acute angle. The dorsal end of the axis is to the outer side of the normal. These distortions assist in the pronounced inward direction of the rudimentary digit.

The proximal articulation (fig. 91 A) consists of a broad but shallow concavity, continuous along the inner lower side, with an offset. The latter surface is continued

upon the palmar side at a right angle, with a small facet for a sesamoid. On the distal surface (fig. 91 c) the articulating facet is much wider transversely than deep. It is concave in the former direction, convex to flattened in the latter, and the inner half is the more extensive area. The outer side (fig. 91 B) is decidedly longer in proximo-distal extent than the inner side. On the upper half of the outer face there is almost invariably present a fairly large nutritive foramen. Leading from the foramen is a groove which extends to the dorsal surface. It is plainly indicated in some specimens and more faintly so in others. These characters are not present, or very rarely so, on the outer face of phalanx I, digit IV, pes. The palmar border of the phalanx is deeply notched at the middle.

The average measurements (in millimeters) of 31 specimens of *Mylodon harlani* are as follows: Dorso-palmar diameter 45.2; greatest width, 39.1; greatest proximo-distal extent of outer side, 29.8.

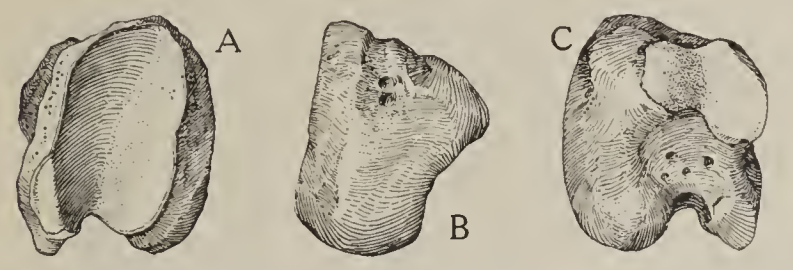


FIG. 91.—*Mylodon harlani* Owen. Phalanx I, digit IV, right manus, No. 24279 U. C. C. *A*, proximal view; *B*, outer view; *C*, distal view. × 0.50. Rancho La Brea Pleistocene.

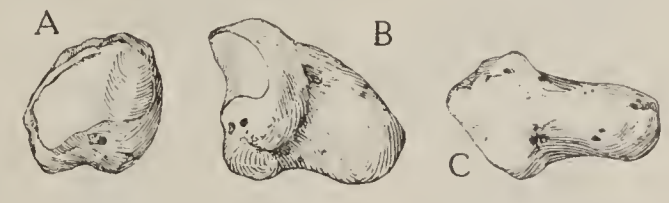


FIG. 92.—*Mylodon harlani* Owen. Terminal phalanx, digit IV, right manus, No. 1484–R–2. *A*, proximal view; *B*, lateral view; *C*, dorsal view. × 0.50 Rancho La Brea Pleistocene.

RUDIMENT REPRESENTING PHALANGES II AND III, DIGIT IV, MANUS.

This element (fig. 92, A, B, C) is very similar to the corresponding rudiment of the fourth digit of the pes, but appears to be, on the average, somewhat smaller than the latter. At the proximal end the articulating surface varies considerably in extent. This segment has also undergone distortion, as is shown by the fact that if a perpendicular be taken to the base of the proximal extremity, the principal axis of this face will be oblique and the dorsal end of the axis will lie to the right or left of the perpendicular, according as the element pertains to the right or left manus, respectively.

The average measurements (in millimeters) of 9 specimens of *Mylodon harlani* are as follows: Greatest length, 36.5; depth of proximal end, measured normal to base, 30; width of proximal end, 26.5.

TABLE 84.—*Average measurements (in millimeters) of 34 specimens of metacarpal V of Mylodon harlani.*

Length	107.8
Width of proximal extremity	48.8
Least width of shaft	32.5
Width of distal extremity	40.6
Greatest depth of proximal extremity, measured across unciform facet	51
Least depth of shaft	26.7
Depth of distal extremity	54.4

METACARPAL V.

Metacarpal V (fig. 93, A to E) is the second in length of the anterior series of metapodials. The shaft is of small extent, and the metapodial is chiefly constituted by the proximal and distal extremities, which are large and heavily developed. The proximal end is truncated obliquely by the articulating surface for the unciform. This surface is frequently continuous with, although demarcated by, a ridge from a small concave facet situated at the tip, which articulates with the cuneiform. Along the inner side of the proximal extremity is the facet for the adjoining metacarpal, continuous with that for the unciform over a rounded ridge.

The massive distal extremity (fig. 93 c) bears along the inner margin a flattened facet, elongated in dorso-palmar axis, which articulates with the rudimentary fifth digit. Occasionally a very small facet for a sesamoid is present below this surface.

PROXIMAL RUDIMENTARY ELEMENT, DIGIT V, MANUS.

This is a much reduced segment (fig. 94, A to D) bearing on the proximal end a slightly concave facet which is elongated in dorso-palmar extent and articulates with the metapodial. A very small facet for a distal nodule is situated at the dorso-internal angle of the distal face and is directed upward as well as distally. This facet is directed more upward and less to the distal side than is the corresponding surface on the proximal rudimentary element of digit V, pes. Several specimens in the collections of the Los Angeles Museum show a fusion with the distal nodule (fig. 94, E and F) and indicate that the latter was a tiny element.

FIG. 93.—*Mylodon harlani* Owen. Right metacarpal V, No. 24280 U. C. C. *A*, outer view; *B*, dorsal view; *C*, distal view; *D*, inner view; *E*, ventral view. × 0.50. Rancho La Brea Pleistocene.

The average measurements (in millimeters) of 9 specimens of *Mylodon harlani* are as follows: Greatest depth of proximal end, 34.6; greatest width of proximal end, 24.9; greatest proximo-distal diameter, 21.5.

COMPARISON OF MANUS.

Mylodon harlani agrees closely with the South American *M. robustus* in the structure of the manus. While the individual elements differ somewhat in shape, no change has taken place in the major relationships of the bones or in the reduction of segments.

In dorsal view of manus (plate 35, fig. 1) the pisiform does not always come to view. As in *M. robustus*, the scaphoid sends downward a process, and the trapezium is rarely represented by a separate element. As discussed above (see p. 149) the trapezium has not fused with the scaphoid, but has joined with metacarpal I to form an element in *M. harlani* similar in form to that in *M. robustus*. In both North American and South American mylodonts the claw-bearing phalanges are found in the three inner digits, while the two lateral digits are rudimentary. In digit I of both forms the first and second phalanges have fused, presumably to form a single segment. The distinct inequality in size between ungual phalanges of the second and third digits can not be regarded as a valid difference between *M. robustus* and *M. harlani*, for Stock (1917*c*) has shown that in Owen's figures (R. Owen, 1842, plates 15 and 21) of the manus and pes of the former species the second and third phalanges of digit III, pes, have been interchanged with the corresponding phalanges of digit II, manus.

The manus of *Scelidotherium leptocephalum* differs from that of *M. harlani* in the greater reduction of the innermost digit. In the hand of *S. magnum*, as figured by Winge (1915, plate 39), the inner digit and metacarpal I are comparable in development to those in the North American mylodont.

Catonyx, a near relative of *Scelidotherium*, resembles *M. harlani* in the retention of ungual phalanges in digits I, II, and III and in the rudimentary structure of digits IV and V. According to Lund, and to Schulthess (1920, p. 77), the trapezoid and magnum may unite in the manus of *Catonyx*. A union of these two elements has never been observed in the North American form. In *C. giganteus*, as shown by Winge (1915, plate 31, fig. 1), metacarpals IV and V are more slender than the corresponding metapodials of *Mylodon*.

INNOMINATE BONE.

This element in *Mylodon harlani*, shown in plates 35, 36, and 37, is similar in many of its structural features to that of the South American species *M. robustus*. The great wing-like ilium in *Mylodon* is even more prominent than in *Nothrotherium*, and the upper anterior border is carried much farther forward than in the latter genus. When the os innominatum is viewed from the dorsal or from the posterior side (plates 36 and 37) it is seen that the ridge extending backward from the inner anterior border of the ilium does not approach the spinal ridge as closely as in *M. robustus*. The ridge formed by

FIG. 94.—*Mylodon harlani* Owen. *A* to *D*, phalanx I, digit V, right manus, No. 24281 U. C. C.; *E* and *F*, phalanx I, fused with rudimentary phalanx II, No. 1485–R–5. *A*, proximal view; *B*, outer view; *C*, inner view; *D*, distal view; *E*, proximal view; *F*, outer view. × 0.50. Rancho La Brea Pleistocene.

the fusion of the outer ends of the transverse processes of the sacral vertebrae does not appear to diverge posteriorly as much as in the latter form. Along the inner base of this ridge may be seen the posterior sacral foramina. These foramina increase in size posteriorly. At the base of the anterior portion of the spinal crest is a series of three or more deep depressions into which enter canals that extend through the neurapophysial plate and open inward above the large foramina for the lumbar nerves. The inner surface of the neurapophysial plate between each of these foramina and the large openings for the lumbar nerves is usually marked by a distinct groove. In a specimen of a young individual of *M. harlani*, No. 1719–17, the transverse processes of the two anterior sacral vertebrae are seen to establish the principal connection with the ilium, while those of the last two vertebrae connect with the ischium. The ends of the transverse processes of the intermediate vertebrae form the inner boundary of the sacro-ischiadic foramen.

The inner or anterior and the outer or posterior surfaces of the ilia are shown in plates 36 and 37. In anterior view a well-marked groove is seen to extend from the inner end of the inferior border of the iliac wing to the border of the pelvic opening. The acetabulum is round or oval in shape. The sulcus for the round ligament incises the articulating surface as in *M. robustus*. It is interesting to note that the depression varies considerably in size and in many specimens is actually smaller than in the os innominatum of *Nothrotherium*. In No. 1719–1 the obturator border of the acetabulum is notched, but no depression extends toward the middle of the femoral articulating surface. The sacro-ischiadic foramen is ovate in form. The obturator foramen is relatively smaller than in *Nothrotherium*. The pubis and ischium resemble the corresponding

TABLE 85.—*Mylodon harlani, measurements of pelvis (in millimeters).*

	No. 1719–1	No. 1719–2	No. 1719–3	No. 1719–4	No. 1719–5	No. 1719–6	No. 1719–7	No. 1719–8	No. 1719–9	No. 1719–11	No. 1719–12	No. 1719–16
Greatest transverse width across ilia	1,056.5	[1]1,082	.....	[1]1,045	.....	.....	.....	.....	.....	.....	.....	.....
Dorso-ventral diameter of ilium, measured from anterior border of acetabulum to anterior border of iliac wing	468	458	.....	472.6	492	481	456.4	.....	463.7	457.4	470.4	.....
Transverse width of ilium, measured from dorso-lateral border of pubic opening to external border of iliac wing	429.6	448.3	.....	.....	.....	439	422.8	.....	.....	.....	[1]460	.....
Length of synsacrum, measured from antero-ventral border of most anterior vertebra to postero-ventral border of most posterior vertebra	[2]475.6	[3]564	[4]619.8	.....	[3]575.6	[3]542	[3]545	[1,4]585	[3]524	[3]499	.....	[3]519
Dorso-ventral diameter of pubic opening, measured from mid-ventral border of last vertebra of synsacrum to postero-dorsal side of pubic symphysis	429.6	415	.....	.....	.....	410.4	438.4	[1]460	.....	.....	.....	.....
Width of pubic opening, measured across dorsal borders of obturator foramina	318.7	341	.....	.....	.....	346.5	338.8	343	.....	.....	.....	.....
Width of pubic arch, measured across external surfaces of pubic tuberosities	[1]390	[1]392.3	[1]431	.....	.....	395	429.7	435.7	.....	.....	.....	.....
Width, measured across outer borders of acetabula	562.4	617	.....	594	.....	575.5	614.5	591.4	.....	.....	.....	....
Diameter of acetabulum, measured from the antero-internal to postero-external border	127.8	128.5	144.7	129.9	145.7	135.1	130.7	132.4	135.2	132	137.3	134
Greatest diameter within acetabulum, taken normal to foregoing measurement	127	127	131.5	140.4	133.7	133	122	124	[1]125	.....	133.6	.....
Antero-posterior diameter of sacro-ischiadic foramen	104.2	121.5	.....	101.5	106.3	95	106.9	.....	100.4	91.6	95.7	108.4
Longitudinal diameter of sacro-ischiadic foramen, taken normal to foregoing measurement	122.5	.....	.....	149.3	125	119.2	128.7	.....	131.6	101.8	114.7	127.3
Least distance rom inferior border of sacro-ischiadic foramen to superior border of acetabulum	112.5	121.6	114	110.7	127.8	125.3	101.7	[1]103	115	112.8	124.4	109.2
Greatest diameter of obturator foramen	141.3	135.7	.....	.....	.....	135	126.7	128.6	.....	.....	.....	.....
Greatest diameter of obturator foramen, taken normal to foregoing measurement	81.2	66.6	.....	.....	.....	74	58.3	59.8	.....	.....	.....	.....
Width over ventral surface of synsacrum, taken between nerve-openings situated at base of buttresses supporting acetabula	93.9	94.3	94.5	92.6	91.6	88	93.7	96.4	94.7	98.8	.....	95
Length of pubic symphysis, measured over internal (dorsal) surface	94.8	76.6	88	.....	.....	92.5	78.4	89.2	.....	.....	.....	.....
Posterior thickness of pubic symphysis	74.4	47	61.1	.....	.....	85.9	56.4	61.3	.....	.....	.....	.....
Length of fused neural spine series of synsacrum	.....	.....	[3]560	.....	.....	[3]495.9	.....	.....	.....	.....	.....	.....
Greatest width across outer ends of transverse processes of last vertebra of synsacrum	286.4	307	314	320	.....	345.2	.....	.....	272.6	.....	287	.....
Width of posterior face of last vertebra of synsacrum	.....	84.3	87	.....	91.8	87	82.4	.....	91.5	89.6	89	86
Depth of posterior face of last vertebra of synsacrum	.....	59.3	58.7	.....	63.7	64.5	60.5	52	60.8	59.1	52.8	54.6
Width across postzygapophyses of last vertebra of synsacrum	68.4	64.2	62.4	.....	.....	76.2	.....	64.6	71	58.2	56.4	.....

[1] Approximate. [2] Eight vertebrae. [3] Nine vertebrae. [4] Ten vertebrae.

elements in *M. robustus*. In *M. harlani* the flattened external face of the plate of bone below the border of the obturator foramen extends downward between the converging and thickened anterior and posterior borders. The pubic symphysis is short, with the lower or outer surface forming a distinct tubercle. The pelvic opening appears to be relatively narrower in *M. harlani* than in *M. robustus*.

FEMUR.

The femur of *Mylodon harlani* (plate 38, figs. 1, 1*a*, 1*b*, and plate 39) resembles closely that of *M. robustus*, although the specimens from the asphalt beds average considerably larger (average, 546.4 mm.; shortest, 509.2 mm.; longest, 579.8 mm.). The proportion of thigh-bone to tibia is, however, practically the same for the North American and South American species. The femur of *M. harlani* is decidedly longer than that of *Scelidotherium*, and the proportion of femoral length to tibial length is distinctly less in the latter than that in the Rancho La Brea species.

The head of the femur is directed more to the inner side and less upward than in *Nothrotherium* and more as in the femur of *Hapalops*, but the neck is not distinct. In the femora of *Scelidotherium magnum* and *Catonyx giganteus*, as shown by Winge (plates 40 and 31), the head is directed more distinctly upward than in *Mylodon*. The border of the head on the posterior side is notched to form the depression for the ligamentum teres. In femora from Rancho La Brea this notch varies considerably in extent, and in one specimen it is entirely absent. The notch may be of triangular outline, thus resembling that in *M. garmani*, or it may be similar in shape to that in *M. robustus*. Occasionally a scar extends from the apex of the notch inward toward the center of the articulating surface. On the antero-internal side of the head the border of the articulating surface is usually indented, but the indentation is broader and not so deep as the notch for the ligamentum teres. In one specimen (No. 1704–L–15), however, the antero-internal indentation is very deep, much more so than the posterior notch. The digital fossa is deep and in one specimen (No. 1704–R–14) it is partially divided within by a median vertical partition. The lesser trochanter is not so prominent a feature as it is in the femur of *Scelidotherium magnum* shown by Winge (plate 41).

TABLE 86.—*Average measurements (in millimeters) of 26 specimens of femur of Mylodon harlani.*

Total length, measured from head to inferior surface of inner condyle	546.4
Length, measured from great trochanter to inferior surface of outer condyle	525.2
Transverse diameter of head, measured at base	127.8
Width, measured from inner surface of head to outer surface of great trochanter	282.9
Thickness of shaft at middle of inner border	67.5
Least width of shaft	164.6
Greatest width across distal tuberosities (above condyles)	234.8
Width across condyles	188.5
Width of intercondyloid space	47
Greatest width of inner condyle	88.7
Vertical extent of inner condyle	120

As in the femur of *Nothrotherium*, the lower half of the thigh-bone in *Mylodon* lies in a plane which has been rotated inward somewhat and is oblique to a vertical plane passing transversely through the head and great trochanter. This is to be correlated with the inwardly directed tibia. The smallest transverse diameter of shaft in *M. harlani* occurs distinctly below the middle of the femur. In other words, the least width of shaft is closer to the distal extremity than in the femur of *Nothrotherium*. The femora of *Scelidotherium* and *Catonyx* do not show any marked constriction of shaft, as in *Mylodon*. The anterior surface of the upper portion of the shaft is marked by three longitudinal ridges for muscle attachments. The outermost ridge is situated closer to the lateral border of the great trochanter than that of the femur of *Scelidotherium magnum*. A third trochanter, present in *Nothrotherium* and *Megalonyx*, is lacking in *Mylodon*.

The distal articulating condyles are entirely obscured in anterior view (plate 38, fig. 1). In the femur of *M. harlani* there is a less expanse of bone present external to the rotular groove than in that of *Scelidotherium magnum*. This is much better developed in the femur of *Nothrotherium*. The rotular surface is continuous with the articulating surfaces of the condyles (plate 38, fig. 1*b*), *Mylodon* thus differing from *Nothrotherium*, in which it is separate from both.

PATELLA.

The patella of *Mylodon harlani* (plate 38, figs. 2 and 3) resembles that of the Miocene genus *Hapalops* more closely than does the knee-cap of either *Nothrotherium* or *Megalonyx*. It is much thicker in antero-posterior diameter than the patella of *Megalonyx*, the greatest thickness occurring just external to the median vertical line. On the dorsal side this is produced by a tuberous development which is distinctly elevated above the surrounding surface. In the latter respect *M. harlani* agrees with *M. garmani* and differs from *M. robustus*, *Megalonyx*, and *Nothrotherium*. Occasionally, however, this dorsal tuberosity is not well developed, and the patella appears more like that of *M. robustus*. The femoral articulating surface is broadly convex in transverse direction, with the outer portion slightly concave and the inner portion flattened in dorso-ventral extent. This surface is of greatest dorso-ventral diameter toward the inner side. The ventral process below the surface terminates usually rather sharply. The end is recurved posteriorly, giving the process a decidedly concave posterior surface. Contrasted with patellae of *Catonyx* and *Scelidotherium*, that of *Mylodon harlani* possesses a smaller ventral process which terminates less broadly.

TABLE 87.—*Average measurements (in millimeters) of 34 specimens of patella of Mylodon harlani.*

Greatest depth over all	124
Depth measured from dorsal border of femoral surface to end of ventral process	106.3
Transverse width of femoral surface	108
Greatest thickness through middle of femoral surface	72

TIBIA.

The average measurements for the tibia of *Mylodon harlani* from Rancho La Brea indicate a size slightly larger than that of *M. robustus*. In *Scelidotherium* the tibia is longer and the extremities are relatively narrower than in the lower leg element of *Mylodon*. The tibia of *Catonyx giganteus* reached a much larger size than that of *Mylodon*, according to the measurements given by Winge (1915, p. 163), and is likewise relatively longer with extremities narrower than in the latter. The tibia of *Lestodon armatus* is also considerably longer than that of *Mylodon*.

Viewed in proximal aspect (plate 40, fig. 1*a*), the specimens from the asphalt beds are seen to resemble in general shape the tibia of *M. robustus*. Brown (1903, p. 580), in a comparison of the Nebraska form with *M. robustus*, has noted the difference in shape of outer femoral articulating surface, and has described it as being pyriform in the former. Tibiae from Rancho La Brea frequently exhibit a shape of outer femoral surface similar to that in Brown's specimen, but materials are not lacking in which the inner anterior portion of the facet is fuller in its development and gives the surface an approximation in shape to that seen in *M. robustus*.

Principal support for the femur is furnished by the large inner articulating surface which is borne by the shaft of the tibia. The outer femoral articulation, as described by Lull, is not supported directly by the shaft, but by a strong buttress arising from it. Anterior to the outer femoral articulation is a large extent of rugose surface which descends upon the antero-lateral side of the tibia to form the place of attachment of the ligamentum patellae. The position of this insertion is curiously out of place with reference to the principal face of the tibia and is one of the results of torsion undergone by this element, causing the anterior face to be directed more to the inner side. With

the inward turning the area for attachment of the patella ligament comes to rest adjacent to the upper outer border of the tibia. A small lateral process from the upper portion of the cnemial crest partly, and occasionally completely, incloses a canal for the transmission of vessels lying along the outer base of the crest. In specimen 1702–L–33, in which the fibula has fused with the tibia, this process touches an inwardly directed extension from the fibula, with which it tends to fuse. In *M. harlani* this channel, as developed in front of the outer femoral articulation, is situated farther from the outer border of the surface than in *M. robustus*.

A small facet on the posterior side of the outer femoral surface indicates the presence of a fabella. Along the inner margin of the inner femoral surface a narrow, elongate facet is occasionally present which also articulates with a fabella. The proximal fibular surface is similar in shape and position to that of *M. robustus*. A single broad channel traverses the posterior side of the inner malleolus. In *Nothrotherium* two grooves are present in this region of the tibia. On the distal extremity (plate 40, fig. 1*b*) the fibular facet is sometimes narrower and longer than that in the tibia of the South American species. The shape of this facet varies, however, in *M. harlani*.

The concavity for the reception of the inner process of the astragalus is broad or narrow, depending upon the size of the process. The rugose distal surface of the tibia lying adjacent to the inner posterior border of this surface is pierced by several large nutrient foramina.

Proportion of length of tibia to length of femur is as 0.452 is to 1.

In *Scelidotherium leptocephalum* the lower leg, in proportion to the thigh, is longer than in *Mylodon*. This is indicated by the ratio, length of tibia : length of femur as 0.642 : 1. A slight amount of variation is shown by the individuals whose measurements are given by Winge (1915, pp. 201–202), and the ratio may range from 0.631 : 1 to 0.652 : 1. Gregory[a] gives the tibio-femoral ratio for *Lestodon armatus* as 0.51 : 1.

TABLE 88.—*Average measurements (in millimeters) of 32 specimens of tibia of Mylodon harlani.*

Length, measured from intercondyloid eminence of proximal extremity to distal spine	247.3
Greatest length along inner side	246.3
Greatest distance across proximal extremity	185.2
Greatest thickness across inner femoral surface measured along principal axis	123.2
Least thickness of proximal extremity measured between femoral surfaces	87.3
Least width of shaft	93.8
Greatest width of distal extremity	142.5
Greatest thickness of distal extremity	101.9

FIBULA.

In *Mylodon harlani* the fibula (plate 40, figs. 3 and 4) is always longer than the corresponding element figured by Owen for *M. robustus*. In the series of specimens from Rancho La Brea the average measures 263 mm. in total length, the shortest giving a measurement of 248.2 mm. and the longest a measurement of 248.7 mm. The fibula described by Brown from Nebraska falls readily within the range in size exhibited by *M. harlani*, and this is true not only for the length of the element but for other measurements as well. The fibula of *Mylodon* described by Williston from Seneca, Kansas, exceeds in total length the largest specimen available from Rancho La Brea by approximately 5 mm. The corresponding measurements stated by Allen for specimens of this element in *M. garmani* approach in the one case (265 mm.) near the average for the Rancho La Brea series and in the other (234 mm.) indicate a size distinctly smaller than the shortest of the latter series.

The proximal extremity of the fibula is truncated mainly by an elongate oval articulating surface for the tibia. The small facet for a sesamoid is a variable feature of the outer anterior surface of this extremity. The hook-like process noted by Brown as

[a] W. K. Gregory. Notes on the principles of quadrupedal locomotion and on the mechanism of the limbs of hoofed animals. Ann. N. Y. Acad. Sci., vol. 22, pp. 267–294, pl. 34, 1912.

extending backward from the end of the tibial surface is present also in tibiae from the asphalt beds, but there are a number of specimens available in which the process is not prominently developed. The tibial surface of the shaft is flattened, while the opposite face is convex. Above the articulation of the distal extremity the tibial surface of the shaft is very rugose and depressed and represents a portion of the end of the shaft which has not fused with the distal epiphysis. The distal extremity is roughly trihedral in shape, the three principal surfaces being the tibial, anterior, and outer. The tibial surface is composed of two parts represented principally by the articulating facets for the tibia and the astragalus. These facets are confluent but demarcated by a right angle. The tibial facet is broad in fore-and-aft diameter, the astragalar facet is of greatest extent in vertical direction and lies close to the anterior border of the extremity. The two articulating surfaces are always confluent over a sharp angle in specimens from Rancho La Brea, and thus the fibula of *M. harlani* agrees with Brown's specimen from the Pleistocene of Nebraska, with the fibula of *M. garmani*, and differs from that in *M. robustus*, in which the two facets are separate. Proportion of length of fibula to length of femur is as 0.481 is to 1.

The average measurements (in millimeters) of 25 specimens of *Mylodon harlani* are as follows: Total length, 263; greatest width of proximal extremity at right angles to vertical axis, 103.6; least width of shaft, 44.3; least thickness of shaft, 24.7; greatest width of distal extremity across anterior face, 73.5; greatest width of distal extremity across outer face, 66.9.

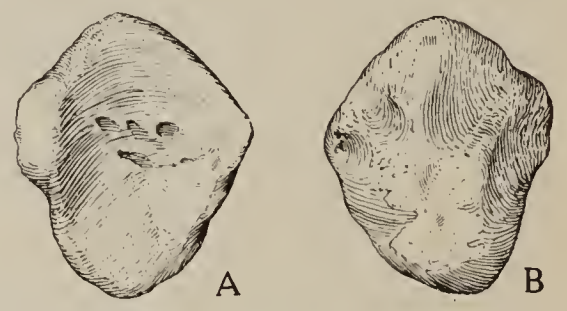


FIG. 95.—*Mylodon harlani* Owen. *A* and *B*, falciform bone of pes, No. 1701. × 0.50. Rancho La Brea Pleistocene.

FALCIFORM BONE OF PES.

Five specimens in the Rancho La Brea collection of the Los Angeles Museum may possibly represent the falciform bone (fig. 95, A, B) of the pes. Such an element is known to occur in the pes of *Scelidotherium*. The specimens from the asphalt beds are rudely quadrangular, with surfaces very much roughened. One of the principal faces is concave and is pierced by several large foramina..

The average measurements (in millimeters) of 5 specimens of *Mylodon harlani* are as follows: Long diameter, measured between opposite apices, 52.7; short diameter, measured between opposite apices, 45.6.

CALCANEUM.

As remarked by Owen, the most noteworthy feature of the calcaneum of *Mylodon* (fig. 96, A to D) and one possessed alike by the South American *M. robustus* and the Rancho La Brea species, is the great development of the posterior portion. There is some variation in the shape of this part of the calcaneum, but in the specimens from Rancho La Brea it is always more or less triangular with the inferior surface, highly rugose, and pierced by a number of nutrient foramina, thus resembling *M. robustus*. In the calcaneum of *Lestodon* a posterior apex is not defined and the border is broadly rounded, and this apparently is true also for *Scelidotherium*. In specimens belonging to immature individuals the greater part of this posterior portion of the calcaneum is seen to be formed by the epiphysis of the bone.

The inferior surface of the posterior region is connected with the anterior extremity bearing the surfaces of articulation by a constricted part which in some specimens may be quite narrow. The tendinal groove, which occasionally may be nearly completely arched, lies along the outer border of this region. The anterior extremity is devoted mainly to articulation with the astragalus. This surface is narrow above, where it is transversely concave, and wide below. Along the outer side the astragalar facet is

convex in dorso-ventral extent. In *Mylodon* the articulation for the astragalus is not divisible into two parts, as it is in *Scelidotherium* and *Lestodon*. Below the astragalar facet, but confluent with it, is the concave facet for the cuboid.

TABLE 89.—*Average measurements (in millimeters) of 21 specimens of calcaneum of Mylodon harlani.*

Length	224.8
Greatest width across inferior side of posterior expansion	123.9
Least width across inferior side of neck	60.2
Greatest width at anterior end, measured across astragalar surface	91.8
Greatest depth, measured across outer side	125.4

ASTRAGALUS.

The astragalus of *Mylodon* (fig. 97, A to D), representing the connecting element between the foot and epipodial segment of the limb, expresses in its peculiar shape the result of a torsion which has caused the entire foot to rest upon the outer side. The dorsal or tibial surface (fig. 97 A) may be considered as of two parts because of their

FIG. 96.—*Mylodon harlani* Owen. Left calcaneum, No. 24282 U. C. C. *A*, ventral view; *B*, outer view; *C*, dorsal view; *D*, view of articular end. × 0.33. Rancho La Brea Pleistocene.

characteristics, although both are directly connected. The inner part forms the prominently convex surface of a process, likened to an odontoid process, which extends inward and somewhat upward. The principal borders of the articulating surface are parallel, or they may converge somewhat to the inner end of the process. The articulating surface is continuous externally, with a broad flange-like or shelf-like area constituting the lateral portion of the tibial articulation. The angle which separates the two parts is pronounced and is as well defined posteriorly as it is anteriorly. In the astragalus of *Nothrotherium* the inner process carrying the tibial surface is shorter, but the latter is broader in antero-posterior extent. The angle between inner and outer portions of the tibial articulation is greater, and the separation is consequently not so well defined, particularly in the posterior region, as in the astragalus of *Mylodon*. In *Scelidotherium* the inner tibial surface is also broader antero-posteriorly than that in *Mylodon*.

The distinction between tibial surface and fibular side is sharp. The former articulation is continuous with a fibular facet along this side (fig. 97 B) which is broad above, but extends to the calcaneal border as a narrow surface. In *Nothrotherium* the fibular

surface is much more extensive in antero-posterior direction, flanking the tibial surface for nearly its entire extent. On the lower side of the astragalus the articulation for calcaneum (fig. 97 c) forms a continuous surface from the posterior end to the border of the cuboid-navicular surface. This is a constant characteristic in specimens from Rancho La Brea and distinguishes *Mylodon harlani* from *Scelidotherium* (R. Owen, 1840, plate 26, fig. 6). On the lower surface of the process bearing the inner tibial articulation above, and seen best in inferior aspect, a knob may be developed which is quite prominent in some specimens from the asphalt beds. The inferior surface for navicular and cuboid is flattened in antero-posterior direction, but possesses a convex curve in transverse extent. It thus resembles the articulation in the astragalus of *Lestodon armatus*, but differs from that in *Scelidotherium* (Owen, figs. 2 and 6), in which a portion of this surface is concave. The anterior surface for the navicular (fig. 97 d), which rounds gently into that portion of the inferior surface articulating also with this element, may show considerable variation in the development of a central depression. The surface may be practically flat or deeply excavated, and there are numerous specimens showing gradations. Lull has noted a similar variation in astragali from the Rock Creek Pleistocene of Texas. The interarticular area adjacent to the inner border of the calcaneal surface is pierced by a number of large nutrient foramina.

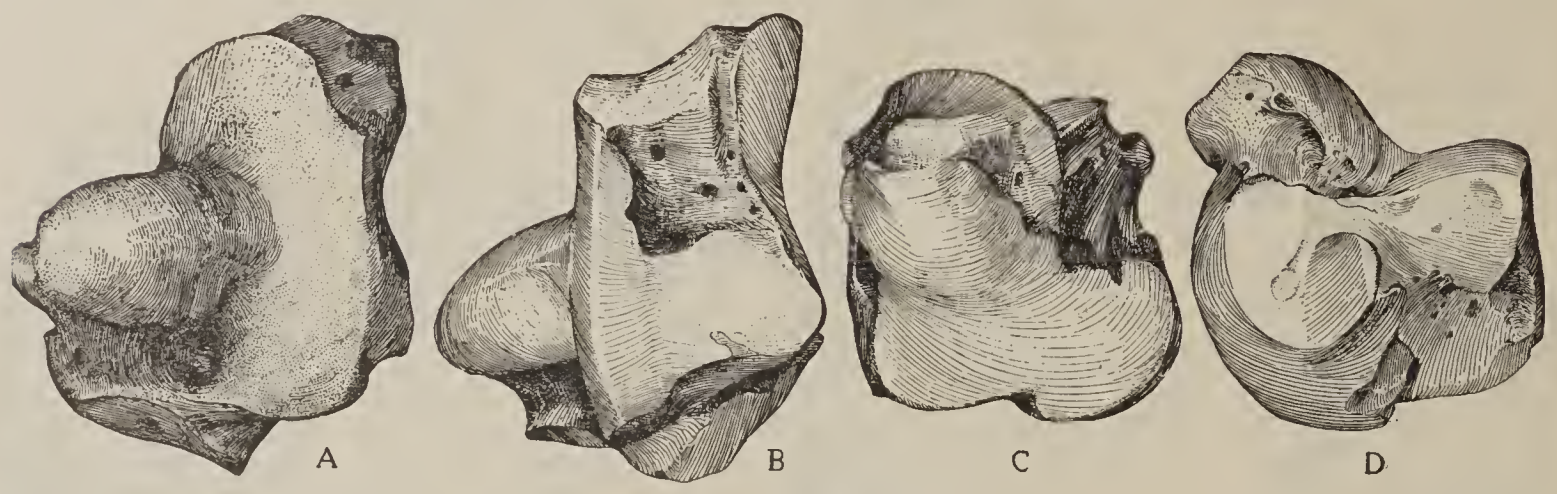


Fig. 97.—*Mylodon harlani* Owen. Left astragalus, No. 23133 U. C. C. *A*, tibial view; *B*, lateral view; *C*, calcaneal view; *D*, distal view. × 0.33. Rancho La Brea Pleistocene.

The average measurements (in millimeters) of 41 specimens of *Mylodon harlani* are as follows: Antero-posterior diameter, 140.2; greatest distance from fibular facet to cuboid-navicular surface across front depression, 104.4; greatest distance from end of fibular facet to end of ascending process with inner tibial surface, 134.3; distance from fibular border of lateral tibial surface to navicular surface, 115.3; antero-posterior extent of lateral tibial surface, 121.4; antero-posterior extent of inner tibial surface, 49.1.

CUBOID.

The cuboid (fig. 98, a to e) is a compact element with dorso-palmar and proximo-distal diameters nearly equal, and with the greatest width across the dorsal surface near the metapodial border exceeding either of these. The greatest extent of articulating surface is that on the distal side (fig. 98 c), which joins with the two elements, metatarsals IV and V. The surface for the latter metapodial is broad, flattened, or slightly convex, being wider toward the dorsal side and narrowing to the palmar side. Continuous along the inner border of this surface is the articulation for metatarsal IV. It is also widest along the dorsal border and the palmar half is a strip deflected along the inner side of the cuboid, thus giving the surface a peculiar curvature. Along the inner side of the dorsal portion the surface is also continuous, but at a right angle, with a small facet for metatarsal III.

On the proximal side of the cuboid (fig. 98 A) is situated the large articulating surface for the astragalus, which is concave in dorso-palmar extent. Along the inner side it is continuous at an obtuse angle, with a surface for the navicular. Occasionally a very small portion of the articulating surface near the dorsal border, and opposite that for metatarsal III, may be deflected still more upon the inner side, and touches the external cuneiform.

Along the entire outer border the astragalar surface is continued at a sharp angle with an articulating surface for the calcaneum. The latter (fig. 98 D) possesses a sigmoid curvature, and is wide above and narrows to the palmar side.

The average measurements (in millimeters) of 32 specimens of *Mylodon harlani* are as follows: Proximo-distal diameter through middle, 54.3; dorso-palmar diameter through middle, 55.3; greatest transverse diameter along metapodial border of dorsal surface, 71.3.

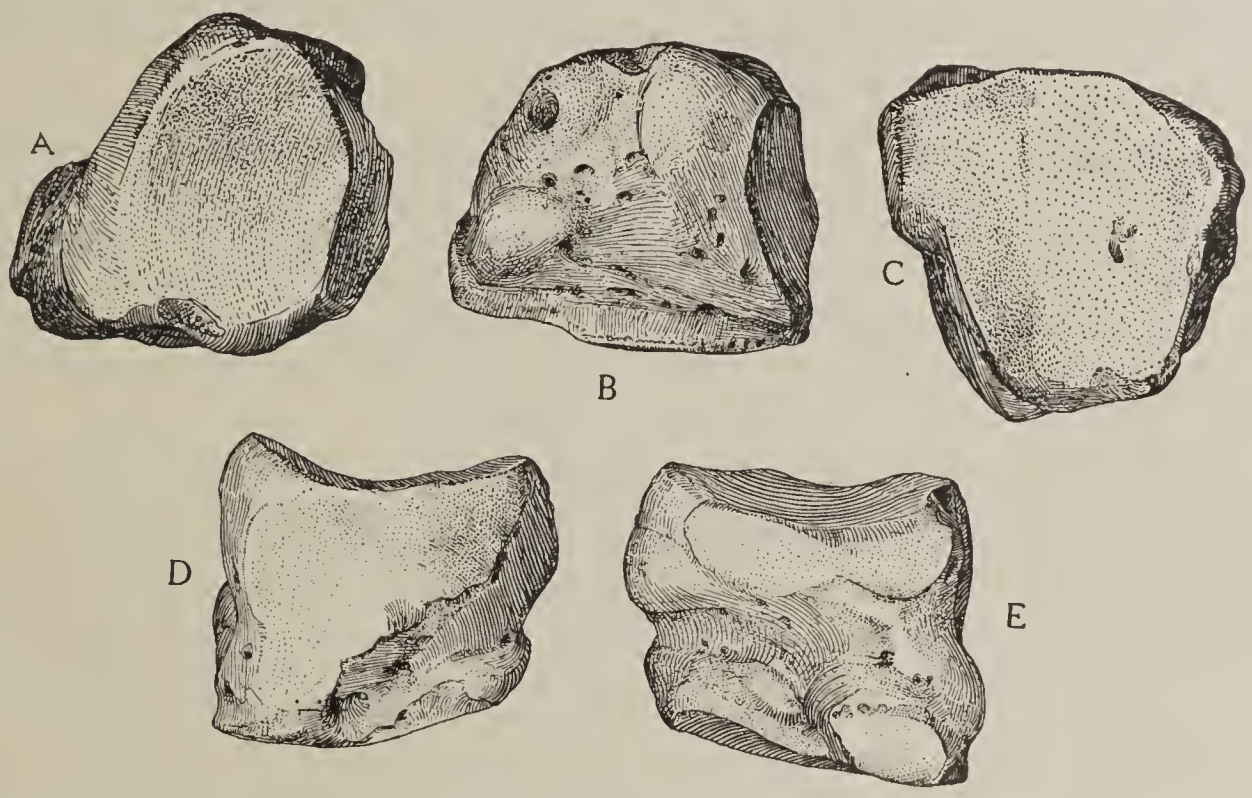


FIG. 98.—*Mylodon harlani* Owen. Left cuboid, No. 23134 U. C. C. *A*, proximal view; *B*, dorsal view; *C*, distal view; *D*, outer or calcaneal view; *E*, inner view. × 0.50. Rancho La Brea Pleistocene.

NAVICULAR.

The navicular (fig. 99, A, B, C) is compressed in proximo-distal direction and decidedly concave in its long axis to accommodate the element in articulation with the astragalus. The proximal surface is entirely devoted to this articulation, and the knob or boss (fig. 99 A), which is a peculiar feature of the surface, is variable in its development. It may be very prominent in some specimens and entirely lacking in others. This variability in the development of the proximal boss, which articulates with a depression in the head of the astragalus, has been noted also by Lull (1915, pp. 377–378) in specimens secured from the Rock Creek Pleistocene of Texas. Along the outer side the astragalar surface of the navicular is continued by a sharp angle, with a narrow but elongated facet for the cuboid (fig. 99 B). For a small extent of its distal border the cuboidal area is continuous with the convex surface on the distal side of the navicular (fig. 99 C), which articulates with the cuneiforms. The latter surface constitutes approximately one-half the width of the distal side and is distinctly shorter than the principal axis of that side. The major portion of the area is devoted to the ectocuneiform and is demarcated only by a faint groove from the adjacent part, which articulates with mesocuneiform. A small inner lobe, distinguishable from the remaining portion of the cunei-

form surface also by a faint groove, may indicate an articulation with a rudimentary representative of the entocuneiform, metatarsal I, and digit I.

The average measurements (in millimeters) of 34 specimens of *Mylodon harlani* are as follows: Greatest length, 85.1; greatest width, 60.5; proximo-distal thickness, 30.

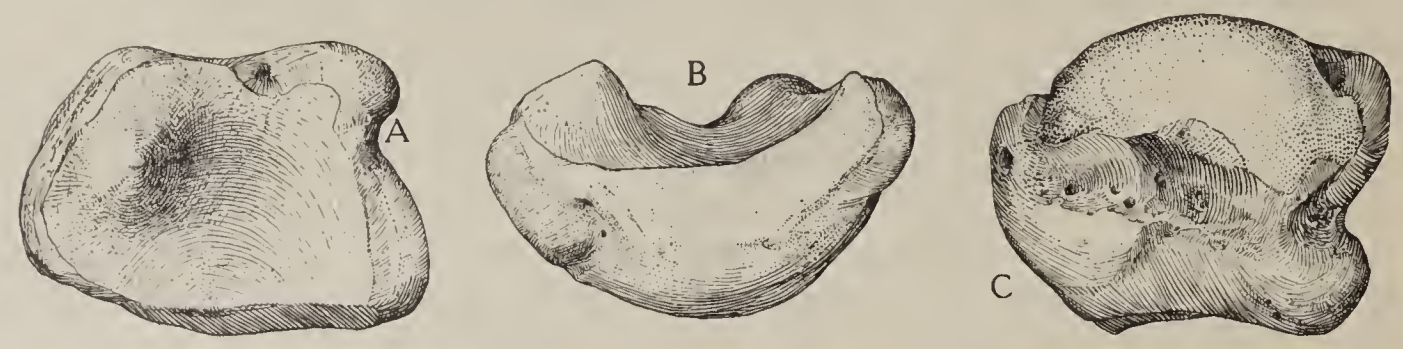


FIG. 99.—*Mylodon harlani* Owen. Left navicular, No. 23135 U. C. C. *A*, astragalar or proximal view; *B*, lateral view showing astragalar and cuboidal surfaces; *C*, distal view. × 0.50. Rancho La Brea Pleistocene.

ECTOCUNEIFORM.

The ectocuneiform (fig. 100, A to D) is a trigonal-shaped bone, with the outer side the longest of the three borders. The proximal and distal surfaces are devoted almost entirely to the support of articulating facets, the former (fig. 100 A) bearing a broad and concave facet for the navicular, and the latter (fig. 100 C), an extensive surface for metatarsal III. The surface for the navicular extends from the angle formed by the dorsal and outer borders diagonally across the ectocuneiform to the inner side. Here it is continued at a right angle with a small articulating surface on the inner side (fig. 100 B) for the mesocuneiform. The latter facet varies much in size; it may sometimes touch the surface for the third metatarsal and occasionally may disappear entirely. In some specimens there is observed a small continuation of the surface for the navicular upon the outer side of the ectocuneiform near the dorsal border. In one specimen (No. 1446–L–17) in which this has occurred a similar slight continuation from the surface for the metapodial is present on the outer side and directly opposite the former surface. It would appear that these small facets articulated with the cuboid. In another specimen (No. 1446–L–12) there is a much more extensive surface deflected, at, however, an obtuse angle from the surface for the navicular, and may have articulated with the cuboid.

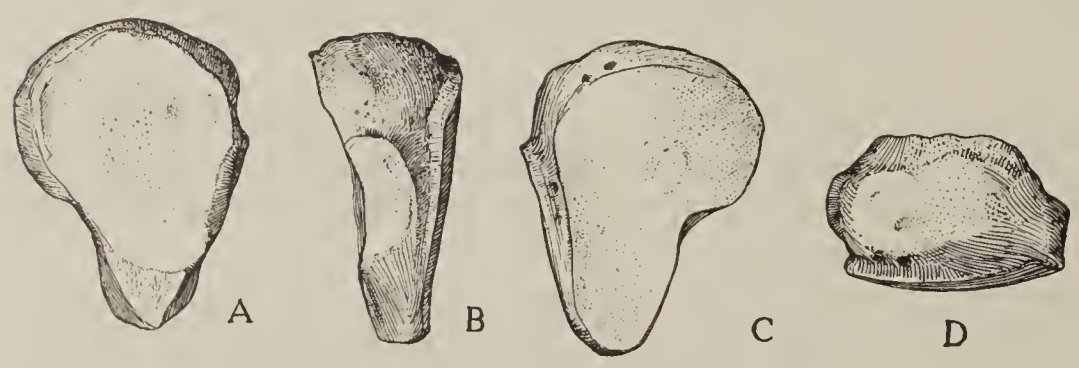


FIG. 100.—*Mylodon harlani* Owen. Left ectocuneiform, No. 23136 U. C. C. *A*, proximal view; *B*, inner view; *C*, distal view; *D*, dorsal view. × 0.50. Rancho La Brea Pleistocene.

The surface for the metatarsal is defined by a raised border, except where this facet is continuous with an articulating surface on the outer side, as noted above.

The average measurements (in millimeters) of 30 specimens of *Mylodon harlani* are as follows: Greatest dorso-palmar diameter, 58.9; greatest width, 44.8; greatest depth of dorsal face, 29.8.

MESOCUNEIFORM.

In *Mylodon harlani* the mesocuneiform (fig. 101, A to D) is compressed laterally and roughly wedge-shaped, with the proximo-distal diameter of the rounded and narrow dorsal surface nearly twice as great as the corresponding diameter of the palmar surface.

The depth of the mesocuneiform may be greater or less than the greatest proximo-distal diameter. The palmar surface is flattened and is wider transversely than the dorsal surface. The outer side is flatter than the inner, and in all specimens from Rancho La Brea bears along the proximal border a facet for the ectocuneiform. There is no indication of a facet along the proximal border of the inner side for an entocuneiform. The proximal articulating surface for the navicular is rectangular in shape and is slightly concave. At the distal end the articulating surface for the metatarsal is placed oblique to the vertical axis of the cuneiform. It is of greater dorso-palmar extent than the proximal articulation and is more deeply concave in that direction. The surface narrows dorsally and in most specimens is constricted at about the middle of the inner side. The mesocuneiform is noticeably larger than in *M. robustus*.

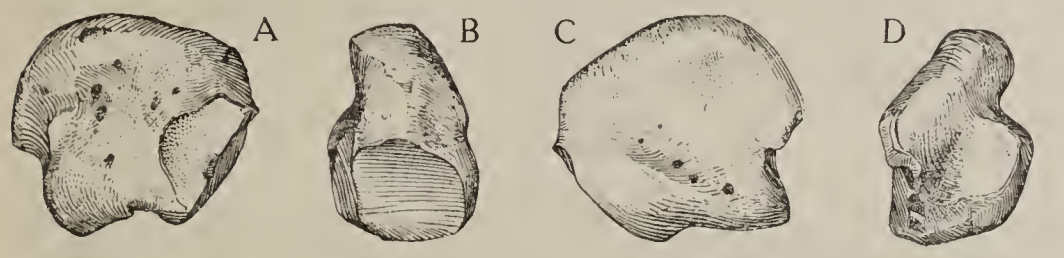


FIG. 101.—*Mylodon harlani* Owen. Left mesocuneiform, No. 23137 U. C. C. *A*, outer view showing at right facet for ectocuneiform; *B*, proximal view; *C*, inner view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

The average measurements (in millimeters) of 16 specimens of *Mylodon harlani* are as follows: Greatest distance between dorsal borders of proximal and distal facets, 38.2; distance between palmar borders of proximal and distal facets, 21.1; greatest width of palmar surface, 27.2; dorso-palmar diameter through middle of mesocuneiform, 37.1.

METATARSAL II.

In *Mylodon harlani* the second metatarsal (fig. 102, A to D) differs decidedly from that of *M. robustus* in its relative length. This element, as compared with that of *M. robustus*, is exceedingly short in proximo-distal diameter, often shorter, in fact, than the mesocuneiform in *M. harlani*. In the marked shortening of metatarsal II, the pes of the latter species may be construed as being more advanced than that of *M. robustus*. It is to be noted, however, that the mesocuneiform is relatively longer in *M. harlani* than in *M. robustus*.

The proximal and distal articulating surfaces of the second metatarsal may almost meet dorsally, giving the specimen a triangular shape in side view. In some specimens the proximal face is almost vertical, and the metatarsal therefore approximates a quad-

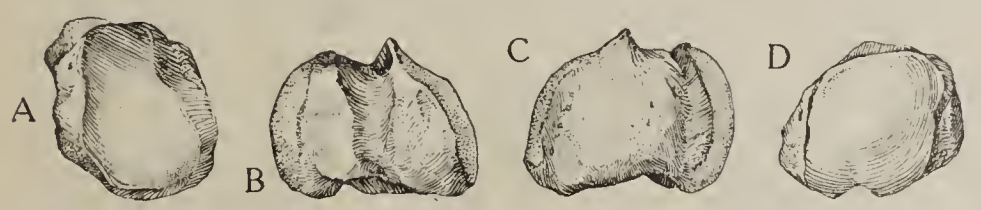


FIG. 102.—*Mylodon harlani* Owen. Left metatarsal II, No. 23138 U. C. C. *A*, proximal view; *B*, outer view; *C*, inner view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

rilateral form. The proximal articulating surfaces (fig. 102 A) conforms in outline to the distal articulating face of the cuneiform and may be convex below and slightly concave above. The distal articulation (fig. 102 D) is elongate in dorso-palmar direction, convex, and faces upward and slightly inward. The lower border of the surface is straight. The inner side of the metatarsal (fig. 102 C) is convex dorso-palmarly, while the outer side (fig. 102 B), as in *M. robustus*, bears a narrow vertical groove, which joins below an excavation between the proximal and distal extremities.

In the series of 20 specimens in the collections of the Los Angeles Museum, representing the right second metatarsal, two (10 per cent) have fused with the mesocuneiform. In such specimens all indications of an original separation are obliterated, although the two elements are easily recognized by their otherwise characteristic shape (see fig. 103,

C, D). These specimens are of especial interest in their great similarity to Owen's figure and description of metatarsal II of *M. robustus*. It suggests, at least, that in the latter species the second metatarsal as determined by Owen may possibly be the homologue of the compound element from Rancho La Brea. In *M. garmani* the cuneiform has fused with metatarsal II only in the right pes.

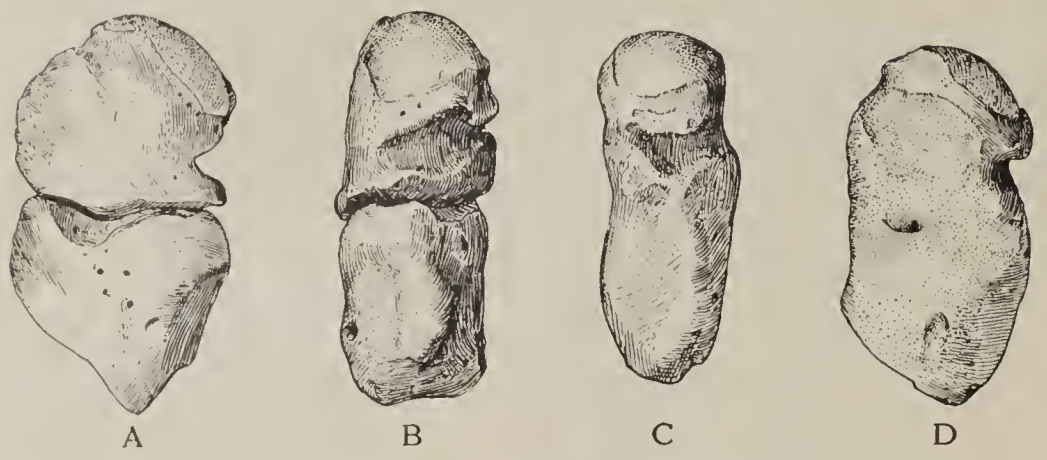


FIG. 103.—*Mylodon harlani* Owen. *A* and *B*, inner and dorsal views, right mesocuneiform and metatarsal II, No. 22771 U. C. C. *C* and *D*, dorsal and inner views of co-ossified mesocuneiform and metatarsal II, No. 22772. × 0.50. Rancho La Brea Pleistocene.

The average measurements (in millimeters) of 18 specimens of *Mylodon harlani* are as follows: Proximo-distal diameter through middle of metatarsal, 36.1; greatest width of distal end measured parallel to base, 33; greatest depth of distal end, 25.8.

CO-OSSIFIED PHALANGES I AND II, DIGIT II, PES.

The compound element representing the fused first and second phalanges of digit II, pes, (fig. 104, A to E) is broader and heavier than its homologue in the first digit of the manus (compare average measurements). The proximal articulating surface (fig. 104 A) is broader than that of the anterior phalanx, and possesses a flattened palmar border and well-rounded dorsal side. The palmar border is notched at the middle for the passage of a tendon to the ungual phalanx. Occasionally this notch is absent. The dorsal end of the principal axis of this surface lies to the left or to the right of the perpendicular to the base, according to whether the phalanx is of the left or right pes respectively, but this deviation from the normal is not as great as in the corresponding element of digit I, manus. The shaft (fig. 104, B, D, and E), although broader, is relatively not so deep as in the element of the manus. At the distal extremity (fig. 104 C) the articulating surface is broader and more evenly divided by a broad median groove into an inner and outer portion. The outer surface extends considerably below the level of the inner surface (seen when element is oriented with base of proximal extremity horizontal). In the homologue of the manus the distal extremity is unevenly divided into an outer and inner division, of which the former is the smaller. The dividing groove tends to flatten out toward the dorsal surface, whereas in the element of the pes it remains distinct throughout its course. The greater expanse of the outer division causes this surface to be carried farther from the outer side of the phalanx of the pes than that of the manus. Posterior to the inner surface and along the side of the distal end is a strong ridge (fig. 104 B) for tendinous attachment, which is not so prominent in the homologue of the manus.

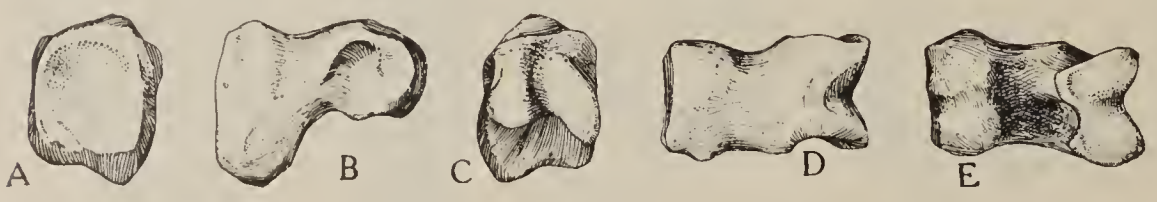


FIG. 104.—*Mylodon harlani* Owen. Co-ossified phalanges I and II, digit II, left pes, No. 23139 U. C. C. *A*, proximal view; *B*, inner view; *C*, distal view; *D*, dorsal view; *E*, ventral view. × 0.50. Rancho La Brea Pleistocene.

The average measurements (in millimeters) of 22 specimens of *Mylodon harlani* are as follows: Total length 37.1; depth of proximal end measured normal to base, 31; width of proximal end, 25.9; greatest tranverse width behind distal articulation 24.2.

PHALANX III, DIGIT II, PES.

This ungual phalanx (fig. 105, A, B, C) is larger and heavier than the corresponding element of digit I, manus. At the proximal end the articulating surface is more evenly divided into two parts by a low vertical and well-rounded ridge. The inner division of this surface is, however, slightly larger than the outer. The subungual base (fig. 105 B) is broader and flattened more than in digit I, manus. This permits the phalanx to rest securely on a level surface, whereas that of the manus can not remain in such a position. On each side of the flattened base and near its proximal end is the foramen for the subungual vessels. These openings do not extend upward along the side of the sheath as they do in phalanx III, digit I, manus, for in the former the vessels supplying the base of the nail and those entering the subungual base pierce the element through openings more closely situated or very often through a single opening.

The claw-process is noticeably thicker than that of phalanx III, digit I, manus, but possesses the same general shape. In both specimens, when viewed in distal aspect, the principal transverse plane of the process is seen to be oblique to the horizontal plane and slopes decidedly downward to the inner side. In several phalanges the bony sheath surrounding the claw-process is well preserved. It forms a strong roof over the dorsal surface and is completely fused with the proximal end.

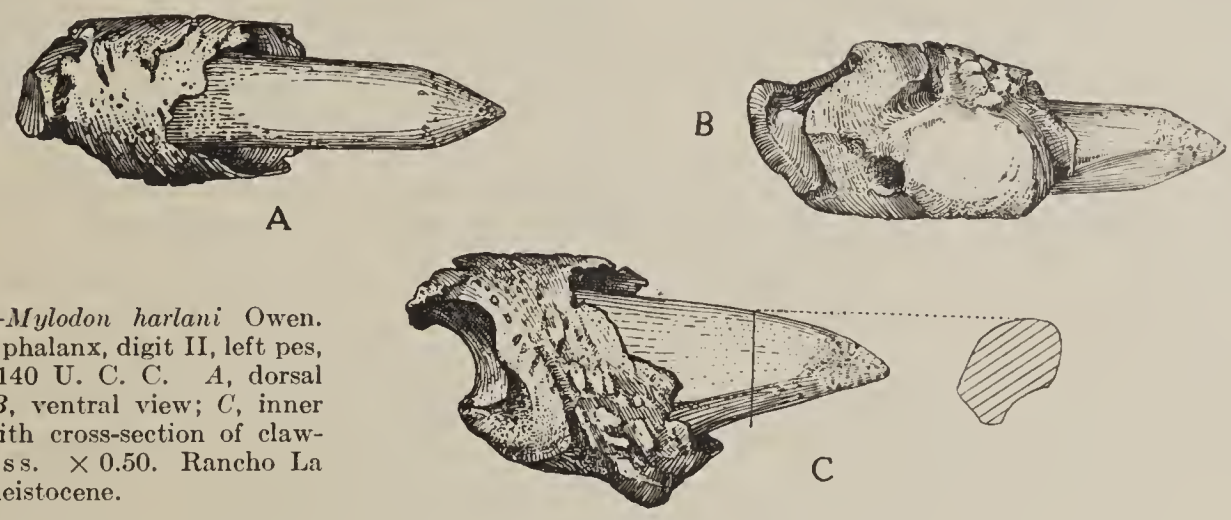


FIG. 105.—*Mylodon harlani* Owen. Ungual phalanx, digit II, left pes, No. 23140 U. C. C. *A*, dorsal view; *B*, ventral view; *C*, inner view with cross-section of claw-process. × 0.50. Rancho La Brea Pleistocene.

Specimens of this phalanx from Rancho La Brea range in total length from 74.3 mm. to 93.7 mm., with an average of 85.3 mm. This length is considerably greater than that of phalanx III, digit I, manus (average 74.8 mm.). In the phalanx of the pes the claw-process ranges in thickness from 17.4 mm. to 22.5 mm., with an average of 19.4 mm. In the corresponding phalanx of digit I, manus, this average is 15.8 mm.

The average measurements (in millimeters) of 22 specimens of *Mylodon harlani* are as follows: Greatest length measured from most projecting part of proximal end to distal end of claw-process, 85.3; depth at proximal end, 33.3; distance from subungual tuberosity to dorsal surface of claw-process, measured normal to dorsal surface, 35.2; greatest width at proximal end, 35.3; width of claw-process at distal end of subungual base, 19.4.

METATARSAL III.

This metapodial (fig. 106, A to D) is short in proximo-distal direction, with the proximal end peculiarly modified to accommodate the metatarsal in its articulation with the surrounding elements. The latter extremity is compressed in the dorsal region to form a wing or process, which apparently overlaps or articulates with the fourth metatarsal to a greater extent in *Mylodon harlani* than in *M. robustus*. The palmar portion of the proximal end is extended downward in a decided process. The dorsolateral wing bears on the inner proximal side (fig. 106 C) a very large facet for the ecto-

cuneiform. Continuous with this facet, but situated on the proximo-palmar surface (fig. 106 D) of the projection, is a small and narrow rectangular facet for the cuboid, while the second largest facet, for metatarsal IV, is confluent, but at a sharp angle with the cuboidal facet, and is directed outward and forward (fig. 106 B). In the left series of 32 specimens, representing metatarsal III, only 1 was noted (No. 1463–L–24) which possessed a very small facet on the palmar projection of the proximal end directed approximately like the dorsal cuboidal facet and undoubtedly also articulating with the cuboid. In the figure of the palmar side of the pes in *Mylodon robustus* (Owen, plate 22) the palmar process of the third metatarsal is shown also to articulate with the cuboid.

FIG. 106.—*Mylodon harlani* Owen. Left metatarsal III. No. 23141 U. C. C. *A*, dorsal view; *B*, outer view with large articulating surface for metatarsal IV; *C*, inner view with large surface for ectocuneiform; *D*, proximal view with large surface on right for ectocuneiform and small surface of articulation on left for cuboid. × 0.50. Rancho La Brea Pleistocene.

The inner side of the shaft in some specimens from the asphalt beds may become quite tuberous near the border of the facet for the cuneiform. At the distal extremity the broadly convex carina is flanked principally along the inner side by an articulating surface, while along the outer side only in the lower region near the sesamoid surface is an offset developed. The sesamoid surfaces are of small extent and are separated by a short and sharp ridge. These bones have not been recognized in the collections.

The average measurements (in millimeters) of 30 specimens of *Mylodon harlani* are as follows: Length measured along outer side of metapodial below surface for metatarsal IV, 64.6; greatest depth of proximal end, 73.8; width of dorso-lateral process at proximal end, 26.1; greatest width of shaft measured across dorsal surface, 41.1; greatest width of distal extremity, 39; greatest depth of distal extremity, 53.9; depth of shaft measured across outer surface, 37.9.

PHALANX I, DIGIT III, PES.

The height of the first phalanx of the third digit (fig. 107, A, B, C) is slightly greater than the basal width. The phalanx narrows but little dorsally from the base. It differs from the corresponding element in the second digit, manus, in possessing a distinctly shorter proximo-distal diameter, with more shallow proximal furrow and flatter condylar surfaces at the distal end. On the proximal extremity (fig. 107 A) the median furrow is flanked along nearly the entire inner side by an articulating offset which widens below. This surface, particularly the lower part, is deflected forward. At the lower end of the outer side of the groove a small offset is also present. These marginal articulating surfaces are continuous below, with facets for sesamoid bones, the outer of which is usually the larger. The palmar border below and between the facets for the sesamoids is concave. At the distal end (fig. 107 C) the

FIG. 107.—*Mylodon harlani* Owen. Phalanx I, digit III, left pes, No. 22769 U. C. C. *A*, proximal view; *B*, inner view; *C*, distal view. × 0.50. Rancho La Brea Pleistocene.

articulating surface for phalanx II is flatter, the median groove being of greater width and the condyles distinctly less prominent than in phalanx I, digit II, manus. The outer portion of the distal articulation is of greater dorso-palmar extent, while the inner approaches more nearly a convexity in transverse profile.

The average measurements (in millimeters) of 29 specimens of *Mylodon harlani* are as follows: Greatest depth, 48.1; greatest width, 42.5; proximo-distal diameter measured across middle of inner surface, 23.2.

PHALANX II, DIGIT III, PES.

The second phalanx (fig. 108, A to H) is frequently only half so large as the corresponding element in the second digit of the manus. The proximal extremity (fig. 108 A) is broad at the base and narrows dorsally to a posteriorly projecting process. The inner of the two articulating surfaces, continuous over a rounded median ridge, is more deeply excavated than the outer. In the second phalanx of digit II, manus, these surfaces are much more deeply excavated. The outer condyle of the distal extremity (fig. 108 D) has a greater depth than the inner, and its articulating surface is flatter.

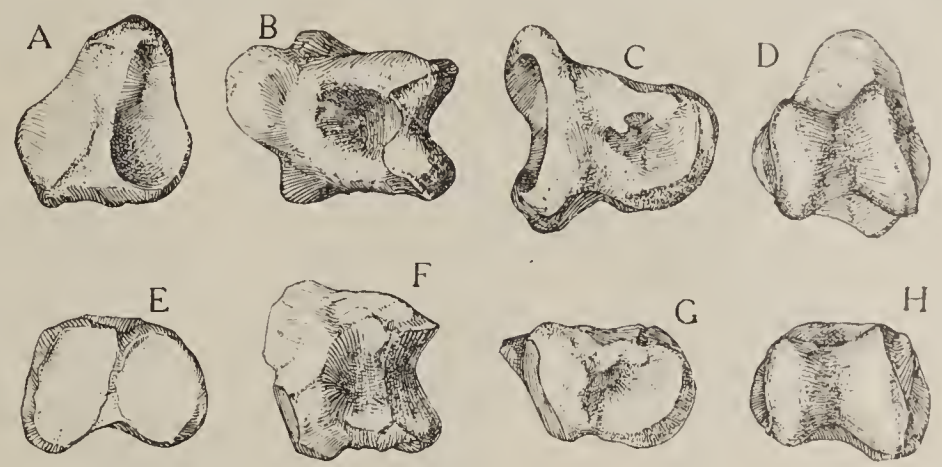


FIG. 108.—*Mylodon harlani* Owen. Phalanx II, digit III, left pes. *A* to *D*, No. 22769 U. C. C.; *E* to *H*, No. 23147 U. C. C. *A* and *E*, proximal views; *B* and *F*, dorsal views; *C* and *G*, inner views; *D* and *H*, distal views. × 0.50. Rancho La Brea Pleistocene.

Several specimens from Rancho La Brea present an interesting variation in the loss of the dorsal process of the proximal end, with a noticeable flattening of the proximal facets (fig. 108 E). On the dorsal surface of such specimens there is often a small facet situated close to the proximal border, and which evidently articulated with an element corresponding to the process in the completely ossified phalanx.

In the right series of 32 specimens, 4 (12.5 per cent) are co-ossified with the first phalanx. The length of the compound element, as measured over the middle of the inner side, is 48.8 mm. in the largest and 42.8 mm. in the smallest specimen. A similar co-ossification occurs in the third digit, pes, of *Megatherium*, *Megalonyx*, and *Nothrotherium*, though it is worthy of note that in the Miocene genus *Hapalops* the two phalanges are separate. Among the Mylodontidae the same structure obtains in *Catonyx* and *Scelidotherium*, but the co-ossified element is broader and more foreshortened than the Rancho La Brea specimens. The two phalanges are separate in *Lestodon*, *Pseudolestodon*, and *Mylodon robustus*.

The lack of any great movement between the separate phalanges, together with the location of principal vertical movement between the first phalanx and the metatarsal in *Mylodon*, may be in part conducive to such co-ossification. It is more probable, however, that the co-ossification of the two phalanges in the genera cited above is to be correlated with the large ungual phalanx of the median digit, which prevails in these forms and requires a rigid support, while in *Mylodon* the relatively much smaller ungual element is accompanied by a more loosely articulating digit. Fusion of the two phalanges in *Mylodon harlani* may depend upon the age of the individual. In both the left and the right pes of *M. garmani* the first and second phalanges of digit III are fused.

The average measurements (in millimeters) of 27 specimens of *Mylodon harlani* are as follows: Length through middle, 35.4; greatest depth of proximal end, 38; greatest width of proximal end, 35.1; depth of inner condyle of distal trochlea, 21.8.

PHALANX III, DIGIT III, PES.

The average measurements of phalanx III (fig. 109, A, B, C) indicate a size distinctly larger than the ungual phalanx of digit II of the pes. There is a range in length from 120.8 mm. at one extreme of the series to 94.7 mm. at the other extreme. It will be seen that although in total length the averages for the terminal phalanges of digits II and III, pes, are quite distinct, the minimum length of phalanx (94.7 mm.) in the latter digit approximates closely the maximum length of phalanx (93.7 mm.) in the former digit. There is not a very great difference in average thickness of claw-process in each type of phalanx.

The two terminal elements are easily distinguishable, however, by their structural peculiarities. At the proximal articulation the posterior projection of the dorsal surface ends in a rather broad surface which is often deeply indented for tendinous attachment.

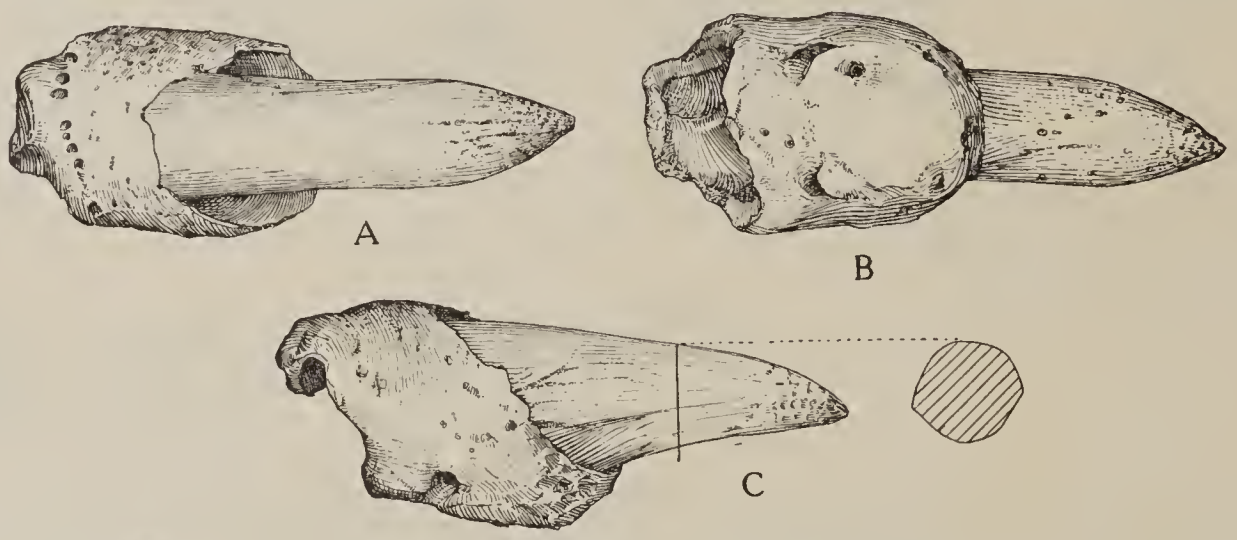


FIG. 109.—*Mylodon harlani* Owen. Ungual phalanx, digit III, left pes, No. 23142 U. C. C. *A*, dorsal view; *B*, ventral view; *C*, inner view with cross-section of claw-process. × 0.50. Rancho La Brea Pleistocene.

In the phalanx of digit II, pes, this process ends more sharply and tends to overhang more the inner articulating surface. The distal discoid area of the subungual base (fig. 109 B) is flattened and in some specimens is quite prominent. The subungual foramina are of unequal size, the inner being larger than the outer foramen. In the corresponding phalgnx of digit II, pes, these foramina are subequal. The difference in size of these foramina in the former phalanx appears due to the fact that on the inner side vessels supply both the base of the nail and the subungual base, while through the outer foramen passed vessels which supplied only the base of the nail.

When the phalanx is viewed in distal aspect the claw-process is seen to differ from that in the third element, digit II, pes, in that the principal transverse plane is nearly horizontal and not decidedly oblique, as in the latter. When viewed in dorsal aspect (fig. 109 A), the claw-process in some specimens appears to bend outward to a slight degree. Occasionally the bony sheath is well preserved and is seen to extend over the claw-process, being fused completely with the proximal border.

The terminal element is considerably shorter and smaller in every respect than the corresponding phalanx in digit II, manus (compare average measurements). It ranks next to the latter in size.

The average measurements (in millimeters) of 26 specimens of *Mylodon harlani* are as follows: Greatest length measured from most projecting part of proximal end to distal end of claw-process, 111.1; depth at proximal end, 39.8; distance from discoid

area of subungual base to dorsal surface of claw-process, measured normal to dorsal border, 39.9; greatest width at proximal end, 42.6; width of claw-process at distal end of subungual base, 21.8.

METATARSAL IV.

In comparison with the fourth metacarpal, the corresponding metapodial of the pes is only slightly shorter (compare average measurements), but differs noticeably in the greater oblique truncation of the proximal end (fig. 110 B). The truncating surface, which along the inner side reaches almost one-half the length of the bone, is composed principally of two articulating facets, namely, for the cuboid and metatarsal III. Both facets are usually confluent (fig. 110 A) and demarcated by a faint ridge. In the left series of 31 metapodials from Rancho La Brea, only 2 were noted in which the two facets are actually separated by a rugose interarticular area. The dorsal portion of the cuboidal facet lies in the general oblique plane with the surface for metatarsal III. Its lower portion, which reaches along the palmar extension of the proximal end, is turned proximally to face more truly in that direction. The proximo-palmar process of the third metatarsal may sometimes touch the lower end of this surface. In the fourth metatarsal of *Mylodon robustus* (Owen, plate 21) the facets for cuboid and metatarsal

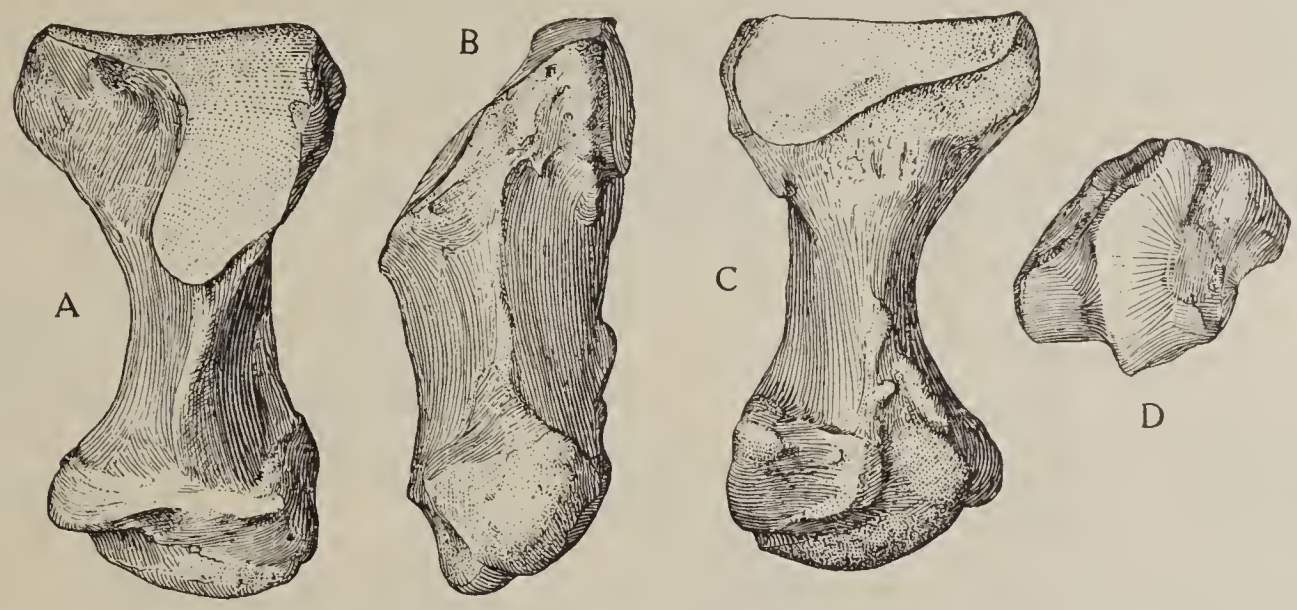


FIG. 110.—*Mylodon harlani* Owen. Left metatarsal IV, No. 23143, U. C. C. *A*, inner view; *B*, dorsal view; *C*, outer view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

III are apparently demarcated by a distinct angle and the former surface is of greater extent, as inferred from the dorsal view, both of which characters are not true for *M. harlani*.

Along the outer border of the proximal extremity (fig. 110 C) is the articulating facet for the fifth metatarsal. This surface is plane, wide dorsally, and narrows considerably toward the palmar end. Its surface dorsally is separated from the plane of the cuboidal facet by an acute angle. The shaft is of less depth than that of metacarpal IV. There is some similarity in distal extremities between the fourth metapodials of the manus and pes. Both show the effect of torsion, and the articulating surface indicates in each case a reduced digit. The carina is somewhat more prominent in metatarsal IV (fig. 110 D), but there is no large tuberous development of bone at the dorso-lateral side of the carina, as in the fourth metacarpal. Along the lower inner side of the carina in metatarsal IV a relatively broad offset is present, while along the outer side in this region a marginal surface may show incipient development. The sesamoid surfaces are separated by a shorter and thicker ridge than in metacarpal IV. Extending backward from this ridge in the posterior metapodial is often a pronounced process of bone.

The average measurements (in millimeters) of 29 specimens of *Mylodon harlani* are as follows: Greatest length measured along outer side close to dorsal border, 119.3; greatest depth of proximal end measured along proximal border, 60.7; greatest width of proximal end, 45.5; least width of shaft, 36.3; least depth of shaft, 27.; depth of distal end, 50.1; width of distal end, 43.5.

SESAMOID BONES FOR METATARSAL IV.

These structures may be described with equal propriety when the first phalanx of the fourth digit is considered, since they are intimately related to the lower extremity of the latter element. Their close association with the first phalanx is evidenced by the fact that they are occasionally fused with the base of the latter. In the left series of 27 specimens of phalanx I, digit IV, pes, 1 is fused with an inner sesamoid, 2 indicate fusion with an outer sesamoid, and 1 possesses both inner and outer sesamoid bones which have united with the base. In the right series of 25 specimens, 4 phalanges are fused with an outer sesamoid, 1 with an inner sesamoid, and 2 have united with both sesamoid bones. In specimens where both sesamoids are present, the latter do not unite across the middle, but excrescences of bone are developed on the inner side of each sesamoid, indicating an attempt at such a union. In addition to the sesamoid bones fused with the first phalanx, there are available in the collections of the Los Angeles Museum two separate outer sesamoids of the right side and one right and one left specimen tentatively determined as outer sesamoids, and two inner sesamoids of the left side.

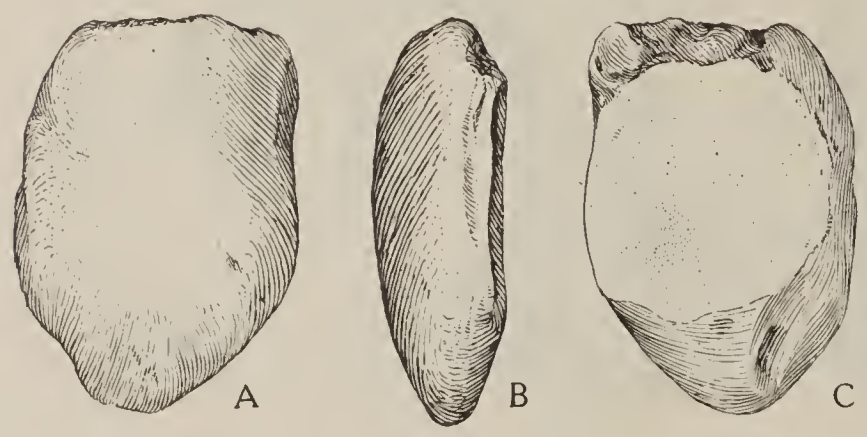


Fig. 111.—*Mylodon harlani* Owen. *A*, *B*, and *C*, outer sesamoid bone, digit IV, left pes, No. 1493–L–1. × 1.0. Rancho La Brea Pleistocene.

Fig. 112.—*Mylodon harlani* Owen. *A* and *B*, inner sesamoid bone, digit IV, pes, No. 1444–L–1. × 1.0. Rancho La Brea Pleistocene.

Since the outer side of phalanx I is longer in proximo-distal extent than the inner side, the sesamoid bone (fig. 111, A, B, C) which lies below it is likewise larger than the inner. The outer palmar surface of the sesamoid is smooth and convex and forms a continuation downward of the outer surface of the phalanx. On the side articulating with metatarsal IV there is a large, broad facet which continues downward the outer portion of the median groove of the phalanx. The outer part of this facet may be deflected upon the outer side, where it then forms a palmar continuation of the small articulating surface or offset along the lower outer margin of the groove in phalanx I, when such an offset is present. Continuous with the larger articulating face at a right angle is a small facet situated on the inner side of the dorsal surface of the sesamoid, which joins with the base of the phalanx.

As already stated, the inner sesamoid bone (fig. 112, A, B) is smaller than the outer. A prominent ridge extends the length of the palmar surface in specimens examined. This sesamoid bears three facets in its dorsal half, all of them continuous but situated on different surfaces. The sesamoid articulates by a small facet on the dorsal surface with the base of the phalanx. Another facet, the largest of the three, which articulates with the metapodial, forms a palmar continuation of the broad articulating offset along

the lower inner border of the median groove of phalanx I. It rounds into a much smaller surface on the outer side of the sesamoid, which also articulates with the metapodial and forms a continuation of the inner palmar portion of the groove of phalanx I.

TABLE 90.—*Measurements (in millimeters) of inner and outer sesamoid bones for metatarsal IV.*

	Inner, No. 1444–L–1.	Inner, No. 1444–L–2.	Outer, No. 1493–R–1.	Outer, No. 1493–R–2.
Length.....	33.6	36.2	35.9	30.7
Width.....	19	19.5	22.9	24.3
Thickness.....	14.4	18	15.9	15.7

PHALANX I, DIGIT IV, PES.

In general form this phalanx (fig. 113, A, B; fig. 114, A, B, C) resembles closely the corresponding element of digit IV, manus. It approximates the latter in size (compare average measurements), but it is absolutely and relatively wider. In this element the distal articulating surface has shifted somewhat to one side of a median vertical plane and the outer side is of greater length than the inner. The presence of foramina on the outer side is more variable in this phalanx than in that of the manus, and when these are present their position is usually closer to the dorsal edge, they are not so large, and there is usually no groove present extending from the foramina to the dorsal surface. The nutritive foramina immediately below the distal articulating surface are smaller and less prominent features in the element of the pes than in that of the manus.

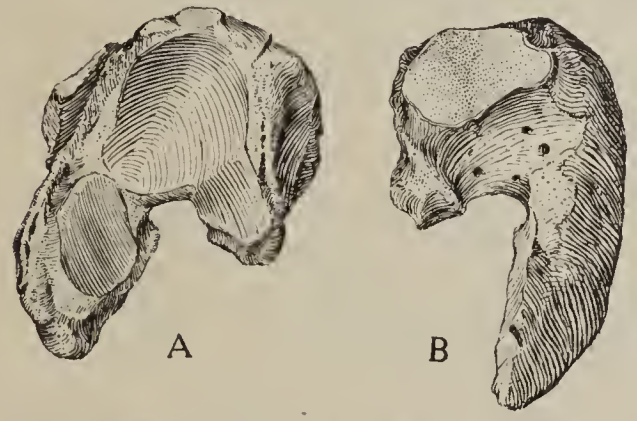


FIG. 113.—*Mylodon harlani* Owen. Phalanx I with outer sesamoid, digit IV, left pes, No. 1453–L–15. *A*, proximal view; *B*, distal view. × 0.50. Rancho La Brea Pleistocene.

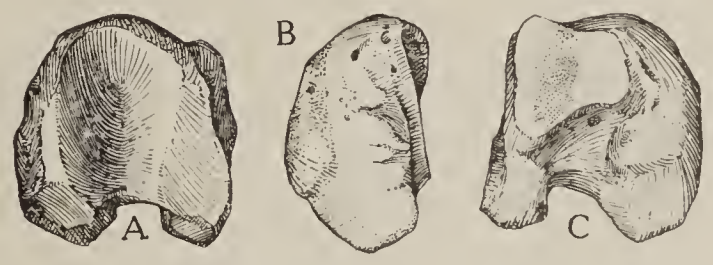


FIG. 114.—*Mylodon harlani* Owen. Phalanx I, digit. IV, left pes, No. 23144 U. C. C. *A*, proximal view; *B*, outer view; *C*, distal view. × 0.50. Rancho La Brea Pleistocene.

The proximal articulation (fig. 114 A) consists principally of a broad median groove extending from the dorsal to the palmar border, and which is much deeper than that of the corresponding phalanx of the manus. Occasionally the groove may be shallow, but as a general rule the depth of the median furrow readily distinguishes this element from the corresponding phalanx of the manus. Along the lower part of the inner border of the groove is an articulating surface continuous at an obtuse angle with that of the groove. The surface resembles that in the phalanx of the manus, but is smaller, being wider transversely, but not extending along the margin of the groove as far as it often does in the latter. An articulating surface may be present also along the lower outer border of the groove, but it is of smaller extent than that on the inner side. This surface is not represented in phalanx I, digit IV, manus. Both the inner and outer surfaces are continuous below, with small facets on the palmar surface for the sesamoid bones. That below the outer side is the larger. In the phalanx of the manus a facet for a sesa-

moid is never present below the outer side, and only occasionally is a slight indication of one seen below the inner side.

The distal surface of articulation (fig. 114 C) resembles that in the corresponding phalanx of the manus. Its inner portion may be quite flattened or convex. The phalanx is notched on the palmar side, and this indentation is broader than in the phalanx of the manus.

The average measurements (in millimeters) of 25 specimens of *Mylodon harlani* are as follows: Dorso-palmar diameter, 45.2; greatest width, 44.8; greatest proximo-distal extent of outer side, 28.7.

RUDIMENT REPRESENTING PHALANGES II AND III, DIGIT IV, PES.

The reduction of the second and third phalanges in the fourth digit of the pes (fig. 115, A, B, C) results in an element which resembles somewhat in general shape the corresponding element in the manus. It is, however, on the average slightly larger than the latter, with the distal extremity heavier or more swollen transversely. The proximal end (fig. 115 A) bears an articulating surface which is usually of greater area in the rudiment of digit IV, pes. The palmar border of this extremity is generally without a median notch, although one or two apparent exceptions to the rule have been noted. In the distal rudiment, digit IV, manus, a small groove on the palmar side, which forms a notch in the palmar border of the proximal end, is almost invariably present. When the element of the pes is viewed from the side (fig. 115 B) the dorsal border extends forward and suddenly descends steeply to the distal end. This gives the element a "roman-nose" appearance in lateral aspect. In the corresponding rudiment of the manus the dorsal border descends, as a rule, with a more gradual slope from the proximal to the distal end and the "roman-nose" effect is not so pronouncedly developed. An exception to the rule is indicated by specimen 1484–R–5, which undoubtedly articulates with a first phalanx (No. 1480–R–20) of the fourth digit, manus. This specimen is much shortened in proximo-distal axis and the "roman-nose" character is well developed.

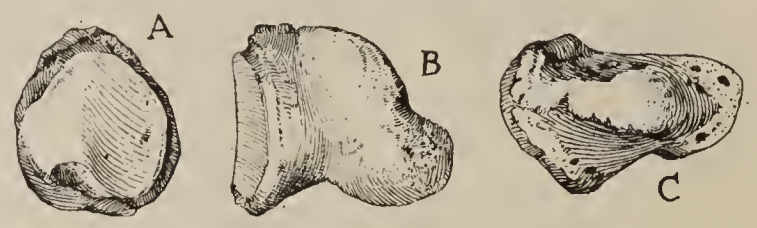


FIG. 115.—*Mylodon harlani* Owen. Rudiment representing phalanges II and III, digit IV, left pes, No. 1450–L–2. *A*, proximal view; *B*, inner view; *C*, dorsal view. × 0.50. Rancho La Brea Pleistocene.

The average measurements (in millimeters) of 11 specimens of *Mylodon harlani* are as follows: Greatest length, 41.3; depth of proximal end, 32.9; width of proximal end, 30.3.

METATARSAL V.

In *Mylodon harlani* the fifth metatarsal (fig. 116, A, B, C) is a heavy element, with well-developed and broadened proximal heel suited to assist in the support of the pes. This heel or heavy lateral process of the proximal end is apparently better formed in the metapodial of the North American species than in that of *Mylodon robustus*, and resembles that in *Scelidotherium*. A surface at the proximal end indicating an articulation between metatarsal V and calcaneum does not occur in any of the specimens from Rancho La Brea. Such an articulation occurs in *M. robustus*, but not in species of *Scelidotherium*. The cuboidal facet (fig. 116 B) is very extensive and is concave in dorso-palmar direction. It is continuous with, but demarcated by an obtuse angle from, the facet for metatarsal IV, which lies on the inner side. In conforming to the surface on the latter metapodial with which it articulated, it is broad dorsally and narrows to the palmar side.

The distal extremity is tuberous, with the outer palmar surface flattened. The facet of articulation for the rudimentary digit exhibits the effect of the torsion undergone by

the metapodial, for when this element rests upon the outer side the principal axis of the facet is close to the vertical. Normally, the position of the axis under such change of position would lie close to the horizontal. The facet is elongated in dorso-palmar extent, often convex above and flattened below. It is often associated on the palmar surface with one or two sesamoid facets.

The average measurements (in millimeters) of 26 specimens of *Mylodon harlani* are as follows: Length from proximal border of cuboidal facet on distal extremity, 113.9; dorso-palmar distance measured along ridge separating cuboidal surface from facet for metatarsal IV, 70.7; distance from surface for metatarsal IV to end of lateral tuberosity, 76.4.

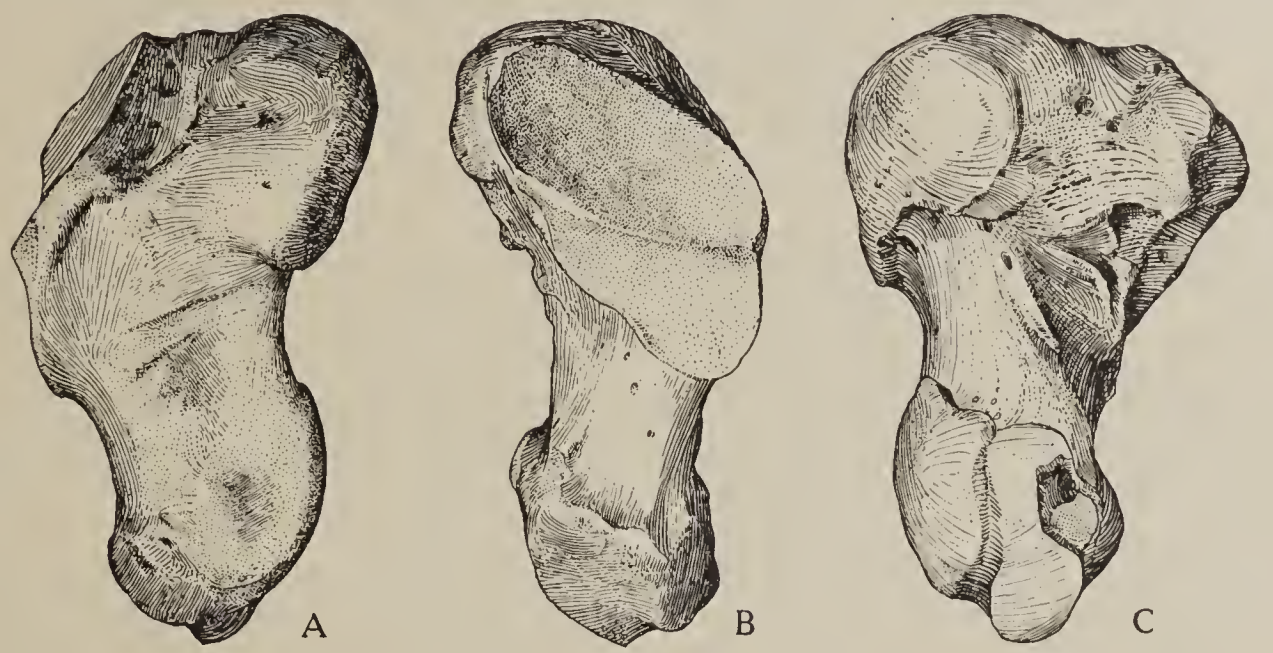


FIG. 116.—*Mylodon harlani* Owen. Left metatarsal V, No. 23145 U. C. C. *A*, dorsal view; *B*, inner view; *C*, ventral view. × 0.50. Rancho La Brea Pleistocene.

PROXIMAL RUDIMENTARY ELEMENT, DIGIT V, PES.

This element (fig. 117, A to E) is very similar to that in the corresponding digit of the manus. It differs from the latter in not being so deep and in being wider transversely and longer in a proximo-distal direction (compare average measurements). At the proximal end (fig. 117 A) the surface articulating with the metapodial is broad, with usually flat sides and palmar margin, and the dorsal margin convex. The palmar surface of the element immediately adjacent to the proximal end is grooved, and this groove may notch the palmar border of the facet. The proximal facet may be concave, particularly in its upper portion, and this concavity may become quite deep, as in specimen 1458–R–4. At the distal end (fig. 117 D) is a small facet for a nodule, this facet being directed inward as well as forward. It is directed more forward and not as much upward as is the distal facet in the corresponding element of digit V, manus. If a median vertical plane be passed through the proximal face, normal to the base, and extended distally, the distal facet is seen to lie well upon the inner side of such a plane. This is true also for the corresponding element in the manus and indicates that in both the front and hind extremities this rudimentary digit has assumed an oblique position. Due to this obliquity, the outer face (fig. 117 B) is longer than the inner (fig. 117 C). The former is relatively smooth, while the latter is more rugose and is marked by a rather broad groove extending from the dorsal to the palmar surface.

Fortunately, there is present in the collections of the Los Angeles Museum one specimen (No. 1458–L–15) of the proximal rudiment, with which is fused the sesamoid element. The latter supports two distinct facets, which articulate with the fifth metatarsal. It is possible that each facet was borne by a separate element, the two having been fused in middle line in the specimen under observation.

The size and shape of the distal nodule is readily inferred from specimen 1458–L–3 (fig. 117 E), in which it is fused with the proximal element.

The average measurements (in millimeters) of 10 specimens of *Mylodon harlani* are as follows: Greatest depth of proximal end, 31.2; greatest width of proximal end, 29.7; greatest proximo-distal diameter, 26.8.

FIG. 117.—*Mylodon harlani* Owen. *A* to *D*, proximal phalanx, digit V, left pes, No. 23146 U. C. C.; *E*, co-ossified proximal and terminal rudiments, digit V, left pes, No. 1458–L–3. *A*, proximal view; *B* and *E*, outer views; *C*, inner view; *D*, distal view. × 0.50. Rancho La Brea Pleistocene.

COMPARISON OF PES.

Comparison with Mylodon robustus.—In number of elements present the pes of *Mylodon harlani* (plate 41) is similar to that of *M. robustus*. In both species digit I has disappeared. The entocuneiform may be also absent, but in some specimens from Rancho La Brea the extent of the articulating surface on the navicular for the cuneiform bones is sufficiently large to support a reduced entocuneiform. The latter element has not been recognized in the collection from the asphalt. Presence of ungual phalanges in digits II and III and the amount of reduction in the fourth and fifth digits are as characteristic of the North American as of the South American species.

Two noticeable differences exist between *M. harlani* and *M. robustus*, namely, (1) the size of the second and third phalanges of digit III, and (2) the size of the mesocuneiform and metatarsal II. In a former discussion of the structure of the pes in *Mylodon*, the conclusion was reached by Stock (1917*c*, p. 277) that in Owen's reconstruction, as figured on plates 21 and 22 of the memoir on *M. robustus*, the second and third phalanges of digit III have been interchanged with the corresponding phalanges of digit II, manus. Thus one of the differences between the two forms to which specific significance may be attached loses its importance.

In *Mylodon harlani* the mesocuneiform is compressed laterally and is roughly wedge-shaped, with the antero-posterior diameter of the rounded and narrow dorsal surface twice as great as the corresponding diameter of the ventral side. This element is larger and appears to differ in shape from that figured in *M. robustus* (R. Owen, 1842, plate 21*f*). The second metatarsal in *M. harlani* is very short, often shorter, in fact, than the mesocuneiform. In contrast, metatarsal II of *M. robustus* (R. Owen, 1842, plates 21 and 22, *m*2) is fully twice as long as the cuneiform with which it articulates.

In the pes of *M. harlani*, as represented by materials from Rancho La Brea, the mesocuneiform rarely unites with the second metatarsal. Such union has been observed in specimen 22772 U. C. C. All indications of an original separation are obliterated, although the characters of mesocuneiform and metatarsal II can still be recognized. Along the proximal margin of the outer side in No. 22772 there is no distinct facet for the ectocuneiform. The specimen is of special interest because of its similarity to metatarsal II of *M. robustus*, as figured and described by Owen (1842, plates 21 and 22, p. 121). There is a suggestion, at least, that in the South American species the second metatarsal as determined by Owen may possibly be comparable to No. 22772 from the asphalt deposits.

Comparison with Lestodon.—The calcaneum in *M. harlani* differs from that in *Lestodon* in its greater constriction below the astragalus, and in the less broadly rounded posterior end. The tendinal groove on the outer border of the calcaneum is larger in

M. harlani. An important difference between the two genera, to which attention has been directed by Gervais (1873), is the division of the astragalar facet. In this respect *Lestodon* is more like the Megalonychinae. Gervais also points out that in general shape the calcaneum of *Lestodon* is more like that element in *Megatherium.*

The navicular in the Rancho La Brea species is less compressed than in *Lestodon,* and the ectocuneiform is thicker in the latter. In the latter also the mesocuneiform and second metatarsal are united. Gervais states that the third metatarsal is relatively much longer than in *Mylodon.*

The second and third digits resemble those in *Lestodon.* In both forms the proximal element in digit II is a composite structure. The ungual of this digit is comparable in size to that of *Lestodon,* and thus both agree in differing from the Pleistocene Megalonychinae. The fourth and fifth digits in *M. harlani* have suffered a reduction similar to that in *Lestodon.*

TABLE 91.—*Measurements (in millimeters) of skulls and mandible of Mylodon harlani tenuiceps.*

	No. 1716–1.	No. 1716–2.	No. 1716–3.[1]	No. 1716–4.
Length from anterior margin of maxillaries to posterior end of occipital condyles	495	486.4	[2]459.4	471.5
Length of palate from anterior end of maxillaries to postpalatine notch	219	217.6	.....	213.2
Greatest width measured across ventral surface anterior to first teeth	136.4	[2]138.6	.....	.....
Width of palate, measured between middle of inner sides of second superior teeth	65.2	70.5	72.6	62.4
Width of palate, measured between inner sides of anterior lobes of fifth superior teeth	38.4	46.2	42.8	41.4
Least width posterior to fifth teeth	52.7	57.4	.....	[2]55.5
Least distance from fifth superior tooth to middle of postpalatine notch	45.6	47.3	.....	50.8
Least distance across ventral margins of pterygoid plates	.....	111.7	.....	.....
Mastoid width above stylohyal processes	184.5	[2]184	[2]167.7	178
Greatest width across occipital condyles	131	132	[2]122.8	118.5
Transverse diameter of foramen magnum	41.4	43.5	42.3	41.4
Dorso-ventral diameter of foramen magnum	38.9	35.5	37.9	38.5
Greatest width of muzzle	133.5	[2]135	[2]131	.....
Least width behind postorbital processes	94.6	97.7	[2]100	91.7
Height measured from plane of basioccipital to dorsal plane	134.8	[2]131.8	128	129.6
Mandible:				
Greatest length of symphysis	.....	.....	[2]92.7	.....
Greatest predental width	.....	.....	98	.....
Depth of ramus between third and fourth inferior teeth, measured normal to inferior border	.....	.....	[2]83	.....

[1] Skull and mandible tentatively referred to *M. h. tenuiceps.*

[2] Approximate.

Comparison with Scelidotherium.—In the pes of *Scelidotherium* the calcaneum is heavy and, as Owen remarks, the posterior end "is broader, and terminated by a less angular convexity than in the Mylodon." According to Schulthess (1920, p. 101), the calcaneal surface of the astragalus is divided, thus differing from that in *Mylodon harlani.*

In *S. leptocephalum* (see H. Burmeister, 1881*a*, plate 1) and in *S. magnum* as shown by Winge (1915, plate 41, fig. 1) the first and second digits of the pes have been reduced, the genus thus exhibiting greater specialization than *M. harlani.*

In the marked widening and shortening of the third metatarsal and the presence of a heavy proximal segment in the digit which supports distally a very large ungual, *Scelidotherium* is decidedly different from *M. harlani* and is strongly suggestive of the Pleistocene Megalonychinae. The large ungual in *Scelidotherium* is supported by the co-ossified first and second phalanges, while in *Mylodon* the corresponding ungual is much smaller and is supported by first and second phalanges, which are usually separate. In the slender fourth metatarsal of the former genus the articulating faces for cuboid and metatarsal III are separated by a distinct angle, while in *M. harlani* they are con-

tinuous in the same plane. In *Scelidotherium* the three phalanges of digit IV are represented. The proximal and middle elements have co-ossified, while the distal or terminal phalanx is rudimentary. In *M. harlani* only two segments of this digit are present, but the middle or second phalanx has not become fused with the proximal element. The reduction of the fourth digit in *Scelidotherium* is, therefore, not so advanced as in *Mylodon*. Burmeister believes that a closer agreement of *Scelidotherium* with *Megatherium* than with *Mylodon* is shown in that "die beiden Metatarsusknochen der zwei äusseren Zehen nur am cuboideum gelenken, und nicht, wie bei *Mylodon*, der äusserste zugleich noch den calcaneus berührt." In *M. harlani* the fifth metatarsal agrees closely in shape with *Scelidotherium*, and does not touch the calcaneum.

MYLODON HARLANI TENUICEPS STOCK.

Mylodon harlani tenuiceps Stock. Univ. Calif. Publ., Bull. Dept. Geol., vol. 10, pp. 171-173, pls. 3 and 4, 1917.

Type specimen 1716–1, a skull (plate 42, fig. 1; plate 43, fig. 5) contained in the Rancho La Brea collection of the Los Angeles Museum.

TABLE 92.—*Measurements (in millimeters) of dentition of Mylodon harlani tenuiceps.*

	No. 1716–1.	No. 1716–3.[1]	No. 1716–4.
Length from anterior end of first alveolus to posterior end of fifth alveolus	146.5	.....	[2]137
Length from anterior end of second alveolus to posterior end of fifth alveolus	119.6	.....	110.8
3, antero-posterior diameter	[2]28.6	.....	[2]23.2
3, transverse diameter	[2]24.3	.....	[2]20.3
4, antero-posterior diameter	22	.....	[2]22.4
4, transverse diameter	23.3	.....	23.7
5, antero-posterior diameter	[2]27.3	.....	22.3
5, transverse diameter	[2]20	.....	18
Length of inferior series, alveolar measurement	.....	130.4	.....
$\underline{1}$, antero-posterior diameter	.....	[2]14.5	.....
$\underline{1}$, transverse diameter	.....	[2]15.4	.....
$\underline{2}$, antero-posterior diameter	.....	25.7	.....
$\underline{2}$, transverse diameter	.....	20.2	.....
$\underline{3}$, diameter of occlusal surface normal to greatest diameter	.....	17	.....
$\underline{4}$, antero-posterior diameter	.....	52	.....
$\underline{4}$, greatest diameter of anterior lobe	.....	[2]28.7	.....
$\underline{4}$, greatest diameter of posterior lobe	.....	[2]19.7	.....

[1] Mandible tentatively referred to *M. h. tenuiceps*.

[2] Approximate.

Subspecific characters.—Skull more constricted behind postorbital processes and cranium more slender than in *M. harlani* from Rancho La Brea. Associated with these characters is a very narrow palate posterior to the fifth tooth. In possessing a slender cranium, the subspecies approaches *M. garmani* more than does the typical *M. harlani* from the asphalt deposits, differing, however, from both in distinctly narrower palate. It resembles the Nebraska skull (No. 2780, Amer. Mus. Coll.) described by Brown in degree of constriction behind the postorbital processes, but differs in having a narrower palate.

Discussion.—The extensive range of variation exhibited by the skull and dentition on *Mylodon harlani* makes it difficult to establish a type absolutely distinct from the parent species. It does not seem possible to establish a series showing gradations between one extreme, as represented by No. 1716–1, and the other extreme as exemplified by No. 21158, Univ. Calif. Coll. Palae., because of difficulties encountered in endeavoring to bridge the gap between the narrow and broad types of skulls.

No. 1717–1 was considered at first to supply a necessary link in establishing a series of nearly perfect gradation, but after further comparison its affinities appeared to be rather more with the broader skulls. In least width of palate and least width of

skull behind postorbital processes (see table of measurements), No. 1717–1 is undoubtedly more like the broader skulls than are the slender specimens referred to *M. h. tenuiceps*. No. 1717–1 belongs apparently to a younger individual than those having the slender skulls, judging from the closure of the coronal and parietosquamosal sutures. These sutures are hardly, if at all, discernible in the latter specimens. It may be possible that the sutures have closed for other reasons than age alone.

An objection to the separation of a new subspecies may be raised by the apparent inconstancy in *Mylodon harlani* of the variations given as characteristic of *M. h. tenuiceps*. No 21160 Univ. Calif. Coll. Palae. can be cited as an example in which a small palatal index is associated with a broad cranium, while in Brown's specimen from Nebraska a small cranial index is associated with a comparatively broad palate posterior to the fifth tooth. It is also worth noting that in *M. garmani*, although the cranial index is very small, the palate is very broad. In establishing the subspecies the writer has been impressed by the lack of continuity in the gradations exhibited by the Rancho La Brea series when the two characters under consideration are taken in combination, rather than by the variability of the characters taken separately.

OCCURRENCE AND DESCRIPTION OF MYLODONTIDAE IN THE PLEISTOCENE OF WESTERN NORTH AMERICA.

GREAT BASIN PROVINCE.

Fossil Lake region, Oregon.—The largest assemblage of Pleistocene mammalian remains known at present from the Great Basin province is that recorded by Cope from sandy beds at Fossil Lake, in south-central Oregon. Waring's[a] geologic reconnaissance map shows Fossil Lake to be situated 7 miles northeast of Christmas Lake, in an area of lake and stream deposits of Pleistocene age. Christmas Lake is approximately 25 miles northeast of Silver Lake. It is to be presumed that all the Pleistocene vertebrate material listed by Cope[b] and others from the region of Fossil Lake was collected in the area lying north and northeast of Christmas Lake. The matter of location will be again referred to in mentioning the Pleistocene vertebrate remains collected by I. C. Russell in the Fossil Lake region.

Unfortunately, the position of the Fossil Lake fauna in the Pleistocene succession of mammalian life in North America has not been definitely determined, for there is still conflict of opinion between geologist and palaeontologist. A consideration of the geological aspects of the problem led G. K. Gilbert to the belief that the accumulation of the deposit at Fossil Lake approximated in time that which occurred in Lake Lahontan and in Lake Bonneville during the last stages of their history. The beds, according to Gilbert, should be referred, perhaps, to the Wisconsin epoch. On the other hand, palaeontological evidence has been regarded as favoring early Pleistocene age of the horizon.[c]

FIG. 118.—Map showing occurrences of Pleistocene Mylodontidae in western North America. 1, Rancho La Brea; 2, McKittrick, Kern County; 3, San Francisco peninsula; 4, Petaluma, Sonoma County; 5, Contra Costa County; 6, Marysville, Yuba County; 7, Hawver Cave, Eldorado County; 8, Carson City, Nevada; 9, Fossil Lake region, Oregon; 10, Dayton, Oregon; 11, Willamette Valley, Oregon; 12, Washtuckna Lake, Washington; 13, Klamath River; 14, Point Conception, California.

[a] G. A. Waring. Geology and water resources of a portion of south-central Oregon. U. S. Geol. Sur., Water Supply Paper 220, plate 6, 1908.

[b] E. D. Cope. The Silver Lake of Oregon and its region. Amer. Nat., vol. 23, pp. 970–982, 1889.

[c] For a recent discussion of this subject, see J. C. Merriam, Univ. Calif. Publ., Bull. Dept. Geol., vol. 10, pp. 517–521, 1918.

The list of mammals known from Fossil Lake has been subjected to several revisions[a] and is given below:

Canis, cf. occidentalis Richardson.
Canis? latrans Say.
Canis ochropus Eschscholtz.
Felis, near oregonensis Rafinesque.
Felis sp.
Felis sp., large.
Ursus sp.
Vulpes, cf. pennsylvanicus Rhoads.
Lutra canadensis Schreber.
Fiber zibethicus Linnaeus.
Microtus sp.
Thomomys sp.
Geomys sp.
Castor sp.
Castoroides sp.
Lepus sp (cf. campestris Bachman).
Mylodon sodalis Cope (? = M. harlani Owen).
Platygonus cf. vetus Leidy.
Platygonus sp.
Eschatius conidens Cope.
Camelops kansanus Leidy.
Camelops vitakerianus (Cope).
?Camelops sp. Max.
Antilocapra sp.
Equus pacificus Leidy.
Elephas columbi Falconer.

We are concerned here chiefly with the species *Mylodon sodalis*, described by Cope (1878, pp. 385, 386) from very fragmentary specimens obtained at Fossil Lake. Since Cope's statement of the characters of *M. sodalis*, considerable doubt has arisen as to the validity of this species. Osborn[b] made the suggestion that the ground-sloth occurring at Fossil Lake may possibly be referred to *Megalonyx*. As indicated in the above list, Matthew regards *M. sodalis* as possibly the same as *M. harlani*.

The ungual phalanx, which Cope (1889, p. 661, fig. 1) considered most distinctive of *M. sodalis*, has been compared with *Mylodon garmani* by Allen (1913), who states that the "description applies well enough to the large ungual phalanx of the forefoot in *Mylodon garmani* but does not indicate that the two are identical." He adds further that "until more material from the same locality and formation is available, it does not seem best to attempt the definite identification of Cope's *Mylodon sodalis*." In a description of *M. harlani* from Texas, Lull (1915) states, with reference to Cope's type material:

"We have therefore in the *M. sodalis* type a larger claw of much the same proportions as the Texas specimens, standing between two in the degree of preservation of the basal sheath. I do not believe, therefore, that Cope's description brings out characters other than those of individual variation or degree of preservation and hence it is entirely inadequate as the characterization of a valid species."

Lull, therefore, considers *M. sodalis* synonymous with *M. harlani*.

Compared with the series of terminal phalanges of *Mylodon* from Rancho La Brea, Cope's specimen appears to resemble closest in shape the ungual of the second digit of the manus. As restored by Cope, the tip of the ungual from Fossil Lake reaches farther below the level of the base of the bony sheath than in any of the third phalanges from Rancho La Brea. The writer agrees with Allen and Lull that the incomplete appearance of the bony sheath in Cope's specimen is due to breakage.

Further materials of the mylodont species from the region of Fossil Lake are available. Portions of the axial and appendicular skeleton of *Mylodon* are in the collections of the U. S. National Museum. Field labels accompanying the specimens state that they were collected by I. C. Russell in 1882, near Button Ranch, Christmas Lake, Oregon.

The writer has not been able to secure information as to the exact location of the Button Ranch. On the sketch map in Russell's report[c] on the geology and water resources of Central Oregon, the location of Button Spring is shown approximately 10 miles north of Christmas Lake.

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[a] W. D. Matthew. List of Pleistocene fauna from Hay Springs, Nebraska. Bull. Amer. Mus. Nat. Hist., vol. 16, p. 320, 1902.
W. J. Sinclair. The exploration of Potter Creek Cave. Univ. Calif. Publ., Amer. Arch. and Ethnol., vol. 2, pp. 17–18, 1904.
J. C. Merriam. Personal communication.

[b] H. F. Osborn. The age of mammals in Europe, Asia, and North America, p. 459, 1910.

[c] I. C. Russell. U. S. Geol. Surv. Bull. 252, plate 1, 1905.

While Button Spring does not necessarily indicate the position of the ranch of that name, such designation presumably implies that the Button Ranch was not distantly located, particularly since Christmas Lake was also given on the labels with Russell's specimens. The following specimens are determined:

No. 3859 U. S. National Museum: Left ramus with third tooth and fragment of fourth tooth, fig. 119; caudal vertebra; right humerus, proximal half; left radius, proximal two-thirds; left manus, cuneiform, unciform, metacarpals II, III, and IV, phalanges II and III of digit II and phalanges I, II, III of digit III, fig. 120; left pes, cuboid, navicular.

Several specimens belonging to a mylodont sloth and collected by Miss Annie M. Alexander at Fossil Lake, in 1901, are in the Museum of Paleontology, University of California. The ground-sloth specimens obtained by Miss Alexander have been determined as a first phalanx, No. 22523, of the second digit of the manus, a third metatarsal, No. 22524, and two caudal vertebrae.

All the remains of *Mylodon*, collected by Russell and bearing the number 3859 (U. S. Nat. Mus. Coll.), were secured from one locality. The collection may represent a single individual. All the specimens indicate a mature animal of rather large size, exceeding in this character *Mylodon harlani* from Rancho La Brea.

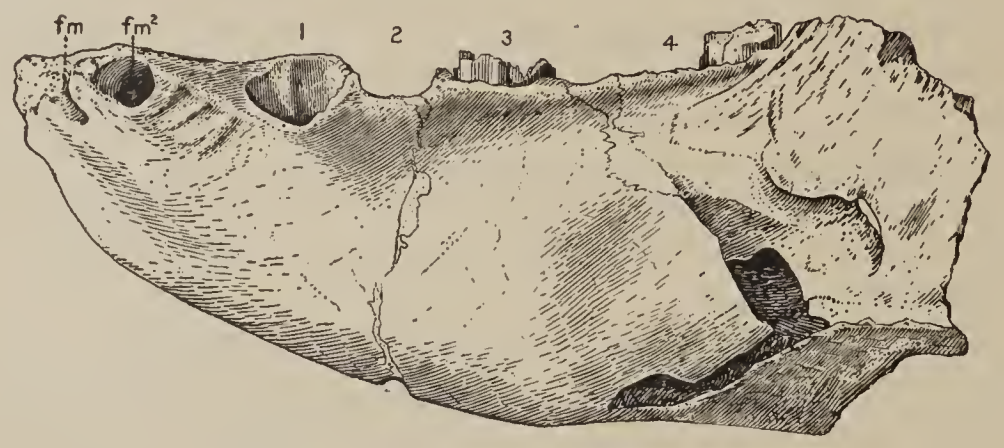

FIG. 119. — *Mylodon*, near *harlani* Owen. Left ramus of mandible, No. 3859 U. S. National Museum. × 0.33. fm^1, fm^2, mental foramina; 1, 2, 3, 4, inferior alveoli and teeth. Button Ranch, near Christmas Lake, Oregon.

The right ramus of *Mylodon* (fig. 119) in the U. S. National Museum collection is large and heavy. The upper portion of the symphyseal region is not preserved, but two large openings of the dental canal occur below the superior border. The posterior foramen lies 27 mm. in advance of the alveolus for the first lower tooth. A small opening is present below and between the two larger foramina. The depth of the ramus between the third and fourth inferior teeth exceeds that in *M. harlani* from Rancho La Brea and is greater also than in *M. garmani*. The third inferior tooth is present while only the posterior portion of $\underline{4}$ remains. $\underline{3}$ resembles closely the corresponding tooth in the species from the asphalt deposits. In $\underline{4}$ the isthmus connecting anterior and posterior lobes does not show a lateral bulging, in which respect the Oregon form resembles *Mylodon harlani* from Rancho La Brea.

TABLE 93.—*Measurements (in millimeters) of ramus of mandible.*

Depth of ramus, measured below anterior border of alveolus of first lower tooth	94.2
Depth of ramus, measured between third and fourth lower teeth and normal to lower border	105.7
Thickness of ramus at $\underline{3}$	50.2
Length of lower tooth series, alveolar measurement	158.6
$\underline{3}$, greatest diameter across occlusal surface	30.6
$\underline{3}$, diameter of occlusal surface normal to greatest diameter	21.4
$\underline{4}$, greatest length, alveolar measurement	66
$\underline{4}$, transverse width of posterior lobe	21.7

A review of the ground-sloth material from Fossil Lake and its vicinity indicates clearly that *Mylodon* occurred in the Pleistocene fauna of this region. The megalonychid sloths are not known to have been present. While exhibiting no noteworthy skull

and skeletal differences from the Rancho La Brea forms, the ground-sloths occurring in and near Fossil Lake during the Pleistocene were apparently larger than the mylodonts from the asphalt. A further recognition of this fact may warrant the grouping of the mylodont sloths of south-central Oregon under a distinct subspecies, for which Cope's name *sodalis* might be retained.

Carson City, Nevada.—The earliest statement known to the writer of the occurrence of Pleistocene vertebrates near Carson City, Nevada, is that by A. R. Conkling,[a] in an appendix to the annual report of the Wheeler Survey for 1877. In this report Conkling notes an outcrop of granular yellow sandstone, underlain by clay, a mile east of Carson, and observes that invertebrate fossils, particularly fresh-water shells, are commonly found in the deposits. Conkling mentions also the finding of vertebrate remains.

The Pleistocene beds near Carson City form a part of a series of such deposits exposed in Washoe, Eagle, and Carson Valleys, along the eastern base of the Sierra Nevada. The geology of the region has been discussed in recent years by John A. Reid.[b] The Pleistocene beds exposed east of Carson City, where the Nevada State Penitentiary is now located, have received considerable attention. In the construction of the prison buildings and the excavation of the prison yard a rock section was exposed, consisting of sandstone with occasional clay layers. The sedimentary accumulation has been regarded as of lacustrine, fluviatile, or aeolian origin. In recent years it has been suggested that the sediments were originally alluvial and aeolian sands and were strongly cemented by hot-spring deposits. The size of the area, character of rocks, the similarity of the sediments to other sandstones in the adjoining region, and the present and past existence of hot springs in the immediate vicinity are considered by W. S. T. Smith[c] as comprising the chief evidence in support of this view.

In the course of the quarrying operations for sandstone at the Nevada State Penitentiary, not only were twigs, invertebrates, and fragmentary remains of vertebrates unearthed, but at a certain horizon there were also uncovered tracks and other impressions of mammals and birds. The Carson footprints were discussed by Le Conte (1882, 1883),

FIG. 120.—*Mylodon*, near *harlani* Owen. Incomplete left manus, No. 3859, U. S. Nat. Mus.; dorsal view. × 0.33. Button Ranch, near Christmas Lake, Oregon.

[a] A. R. Conkling. Geological report on the portions of western Nevada and eastern California between the parallels of 39°30′ and 38°30′ explored in the field season of 1876. Appendix H, pp. 1285–1295. See G. M. Wheeler, Annual Report upon the geological surveys west of the one hundredth meridian in the States and Territories of California, Oregon, Nevada, Texas, Arizona, Colorado, Idaho, Montana, New Mexico, Utah, and Wyoming. Appendix NN of the Annual Report of the Chief of Engineers for 1877.

[b] J. A. Reid. The geomorphogeny of the Sierra Nevada northeast of Lake Tahoe. Univ. Calif. Publ., Bull. Dept. Geol., vol. 6, pp. 89–161, plates 19–28, 1911.

[c] W. S. T. Smith. Origin of the sandstone at the State prison near Carson City, Nevada. (Abstract) Proc. 12th Ann. Meet. Cordill. Sec., Geol. Soc. Amer., Berkeley, Mar. 31 and Apr. 1, 1911, Bull. Geol. Soc. Amer., vol. 23, p. 73, 1912.

Marsh (1883), and others,[a] and from these studies it was concluded that of the vertebrates the ground-sloth, mammoth, horse, possibly deer and wolf, and birds were living in the region during the Pleistocene.

Many tracks are still visible on the floor of the prison yard, where they occur both in the coarse sandstone and in the fine clay layers. The most striking impressions are those of the ground-sloth and mammoth in a stratum exposed on the floor of the yard along the east wall, and particularly where they have been exposed by tunnels into the east wall. Here most of the tracks are shallow and the outlines are clearly defined. Near the west wall and in the sandstone occur footprints, apparently of the ground-sloth, but the impressions are deep and the outlines are not so distinct.

Through the kindness of Mr. R. B. Henrichs, warden of the Nevada State Penitentiary, the writer was permitted to study the footprints in detail and also to make casts of the best-preserved tracks in the prison yard and in the tunnels. The latter task has been accomplished by Mr. J. W. Lytle, of the Los Angeles Museum of History, Science, and Art, and exact reproductions of these footprints have been installed as an exhibit at that museum (plate 46).

Considerable interest is attached to the ground-sloth tracks, for they were regarded at one time as the impressions of the sandaled foot of primeval man. Le Conte (1882, 1883) pointed out, however, certain obvious objections to this view, namely, the large size and the shape of the individual imprint and the span of the straddle as measured by the distance between the right and left imprints. Le Conte considered the possibility that the tracks had been made by a bear or by a ground-sloth, and mentions the suggestion of Marsh that the supposed human footprints were perhaps formed by either *Mylodon* or *Morotherium*.[b] At that time remains of *Mylodon* were known to occur in Great Basin deposits of the same age as the Carson strata. Marsh (1883) expressed an opinion in favor of the view that the tracks were formed by *Mylodon*.

The objections to the quadrupedal origin of the footprints were stated by Le Conte to rest in "the apparent singleness of the tracks, and the absence of claw-marks." The first of these he explained by the observed fact that the imprint of the posterior foot is often superimposed upon that of the anterior foot, while he attributed the second peculiarity to the "clogging of the feet with mud."

Four of the footprints, forming part of the series exposed on the floor of the tunnel in the east wall of the prison yard, are shown in plate 46. Measurements of the tracks are given in the accompanying diagram (see plate 46). The individual footprints in the clay stratum are quite shallow. As indicated in a former paper (Stock, 1917*c*, pp. 284, 285, figs. 5, 6), the imprints correspond in size to the hindfoot of *Mylodon harlani* from Rancho La Brea. They represent the impressions of the hind feet that have been superimposed on and have largely obliterated the imprints of the front feet. The best preserved tracks show a raised border where the soft mud bulged upward along the side of the foot as pressure was exerted downward when the animal walked across the surface of the ground. The lower surface of the track shows sometimes a slightly raised middle region. This elevation corresponds probably to the arch in the foot of *Mylodon* existing between calcaneum and metatarsal V. One end of the footprint is wider than the other and possibly represents the anterior or digital portion of the foot in *Mylodon*. The inner border is always distinctly concave.

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[a] H. W. Harkness. Footprints found at the Carson State Prison. Proc. Calif. Acad. Sci., 7 pp., 5 diag., 1882.

C. D. Gibbes. Prehistoric footprints in the sandstone quarry of the Nevada State Prison. Proc. Calif. Acad. Sci., 8 pp., 4 photos., 3 diag., 1882.

W. P. Blake. The Carson City ichnolites. Science, vol. 4, pp. 273–276, 1884.

G. D. Louderback. Where mammoths roved. Recent discoveries in Carson, Nevada, State prison—footprints that make geologists wonder—theory of their human origin. Sunset Mag., vol. 19, pp. 205–216, frontispiece, 1907.

[b] *Morotherium* is based on a fragmentary humerus belonging to *Mylodon* and a femur belonging to megalonychid ground-sloth. (See pp. 117, 118.)

Mention has already been made of the apparent absence of claw-marks. As shown by the manus and pes of *Mylodon harlani* from the asphalt deposits, the two largest claws possessed by this animal are borne by the second and third digits of the front foot. A close examination of the tracks in the tunnel seems to suggest that an impression was occasionally left of an ungual phalanx (probably the third) of the manus. Such an impression is possibly indicated at *a* in the diagram (plate 46; also plate 47, fig. 1).

Further substantiation of the belief that the footprints which have been discussed were made by *Mylodon* rather than by some other quadruped comes from the presence of osseous remains belonging to this animal, found in the Pleistocene deposits at the prison. The specimens consist of skull fragments and a cervical vertebra embedded in a thoroughly cemented, coarse quartzitic sandstone. The skull remains belonged to an individual possessing 4 upper teeth on the right side and apparently 4 teeth also on the left side.

Washtuckna Lake, Franklin County, Washington.—The Washtuckna Lake locality lies not far to the east of the Ringold Pleistocene[a] of the White Bluffs along the Columbia River. The Washtuckna Pleistocene fauna may have some elements in common with the assemblage from the latter formation, but much more material will have to be collected before adequate comparisons can be made. Matthew[b] cites the following forms from Washtuckna:

Taxidea sulcata (americana), parts of skulls, jaws, limbs, and foot-bones.
Felis, cf. imperialis, parts of limb-bones.
Felis, cf. concolor, parts of limb-bones.
Felis, cf. canadensis, parts of limb-bones.
Mylodon sp., astragali and foot-bones.
Equus sp., bones of feet and some teeth.
? Camelops, cf. kansanus, foot-bones.
? Camelops, cf. vitakerianus, foot-bones.
? Camelops sp., max. foot-bones.
Alces brevitrabalis, parts of antlers, foot-bones, etc.
Alces, semipalmatus, parts of antlers, foot-bones, etc.
Cariacus ensifer, parts of antlers, foot-bones, etc.
Oreamnos, parts of horn.

PACIFIC COAST PROVINCE.

Willamette Valley, Oregon.—The first remains of mylodont sloths from the Willamette Valley were recorded by H. C. Perkins (1842). The specimens were a tooth and a humerus, and for the animal represented Perkins[c] proposed the name *Orycterotherium oregonensis*. G. M. Allen (1913, p. 343) has remarked that the humerus is now in the collections of the Boston Society of Natural History, but the tooth is no longer available. Richard Owen (1843, p. 344) and Joseph Leidy (1855, p. 48) regarded the material as belonging to *Mylodon harlani*.

Allen (1913, pp. 343, 344, plate 4, fig. 16) further describes and figures a fragmentary specimen from the Willamette region. Allen states:

"In the collection of the Museum of comparative zoölogy there is a fragment of the tip of a Mylodon mandible (Plate 4, fig. 16) labeled 'Walhaumet River, Oregon,' which, though it has no further history was evidently received many years ago, before the spelling 'Willamette' for this river was adopted. The bone is stained a dark brown like the humerus from the same locality, and it is probable that it is from the same place or even from the same specimen. Assuming that it represents *M. harlani*, it supplies a portion hitherto undescribed, namely the predental part of the jaw. It includes the tip of the left ramus broken slightly to the right of the middle line of the symphysis, with at its posterior edge the basal part of the socket for the first tooth. It is clearly not referable to *Paramylodon nebrascensis*, in which the symphysis is considerably longer and narrower with a decided keel. From the Mylodon whose skeleton I have just described, it differs equally in the breadth of the truncate tip of the jaw, in the nature of the symphysis, and in the arrangement of the openings of the dental canal. These last in the Oregon fragment consist of two large subequal openings, the anterior 25 mm. in advance of the posterior and some 15 mm. in long diameter, with a very small third opening (4 mm. in diameter) below and between these two. In the other specimen on the contrary, the three openings are in a row, the anteriormost large, the two others small. Further, the symphysis of the Oregon specimen is about 109 mm.

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[a] See p. 110.

[b] W. D. Matthew. List of the Pleistocene fauna from Hay Springs, Nebraska. Bull. Amer. Mus. Nat. Hist., vol. 16, p. 321, 1902.

[c] Amer. Jour. Sci., ser. 1, vol. 44, p. 80, footnote, 1843.

long or some 15 mm. shorter than in the Nebraska species, and there is at its base a flattened triangular area whose apex extends for nearly 70 mm. toward the tip of the ramus. The terminal part of the ramus was much broader transversely than in either Paramylodon or *Mylodon garmani;* it was more abruptly truncate, and about 120 mm. across as against about 85 in the latter species. It therefore more nearly resembles *M. robustus* in having a broad truncate lower lip, and was thus adapted more for a grazing habit, while Paramylodon and *M. garmani* with their elongate and compressed rami, were probably browsing animals."

From a Pleistocene locality near Dayton, northwestern Oregon, on the Yamhill River, a tributary of the Willamette, Ellen Condon McCornack[a] records the finding of ground-sloth, mammoth, and horse. The material consists of two ungual phalanges of the genus *Mylodon.* The specimens are the property of the University of Oregon. The larger of the two phalanges is of digit III, manus. The second specimen probably belongs to digit II, manus. The latter, when compared with a series of ungual phalanges of digit II, manus, of *Mylodon harlani* from Rancho La Brea, is characterized by (1) greater length and (2) relatively greater width of subungual base and of the proximal articulation. No. 1470–L–24 and No. 1470–R–3 in the Los Angeles Museum collections approach the Oregon specimen closely in width of proximal end, but in each of the phalanges from Rancho La Brea the claw-process is distinctly wider. The dorsal surface in the second specimen from the Yamhill locality terminates with a straight posterior edge over the proximal articulation.

TABLE 94.—*Measurements (in millimeters) of phalanges from near Dayton, Oregon.*

	Manus, phal. III, dig. III.	Manus, phal. III, dig. II.
Greatest length, measured from most projecting portion of proximal end to end of claw-process	[1]187	[1]173
Distance from proximal end of subungual base to end of claw-process	[1]147	[1]150
Greatest proximo-distal diameter of subungual base	72.8	80.5
Width of proximal end	[1]56	54.2
Greatest transverse width of claw-process at distal end of subungual base	29.9	29.6

[1] Approximate.

San Francisco Bay region, California.—Marsh (1874) first tentatively recorded the presence of ground-sloths in California in the description of *Morotherium gigas.* Materials consisting of a fragmentary humerus and a femur were said to come from Alameda County, California. A second species, *Morotherium leptonyx,* was based on an ungual phalanx from Pliocene beds of Idaho. Later, Marsh[b] described the genus *Moropus,* two species of which were based on material from the John Day region, eastern Oregon, and a third, a specimen obtained in Nebraska. In the same year Marsh,[c] following the custom of the times, referred both *Moropus* and *Morotherium* to the Edentata. The determination of the relationship of *Moropus* to the chalicotheres led some authors to refer *Morotherium* also to this group.

In 1897, Marsh (1897, figs. 8, 9, p. 144) figured the femur of *Morotherium gigas* and commented as follows:

"To this group [i. e. the Chalicotheria] the genera *Moropus* and *Morotherium,* described by the writer as Edentates, have been recently referred by some authors not familiar with the specimens on which these genera were based. While it is possible that the nature of some of the remains attributed to the former genus may be fairly in doubt, there can be no question that the two known species of *Morotherium* are both true Edentates."

[a] E. C. McCornack. Contributions to the Pleistocene history of Oregon. Univ. Oreg. Leaflet Ser., Geol. Bull., vol. 6, No. 3, pt. 2, p. 18, 1920.

[b] O. C. Marsh. Note of some new vertebrate fossils. Amer. Jour. Sci., ser. 3, vol. 14, pp. 249–256, 1877.

[c] Introduction and succession of vertebrate life in America. An address delivered before the A. A. A. S. at Nashville, Tenn., Aug. 30, 1877.

J. C. Merriam (1899) described a humerus from Pleistocene strata near Tomales Bay, Marin County, California. It resembled closely the known portion of Marsh's specimen and was referred to *Morotherium* by Professor Merriam, although the validity of the genus was questioned by the writer. Stock[a] compared the humerus from near Tomales Bay with specimens of *Mylodon harlani* from Rancho La Brea and concluded that the former belonged to *Mylodon*. This leaves only the femur of *Morotherium* to account for. The latter belongs undoubtedly to a megalonychid ground-sloth (see pp. 117, 118).

Ground-sloth remains from Pleistocene beds in the San Francisco Bay region have been noted by Professor Merriam (1899, 1900) at Bull's Head Point near Martinez and near the station of Rodeo. At Rodeo the Pleistocene deposits rest upon the San Pablo Miocene and the Pinole Tuff Pliocene and are exposed along the shore of the bay. The thickness of the Pleistocene beds near Rodeo is not over 40 feet. In the basal layers occur many oysters and mussels, while the overlying deposits, either of estuarine or alluvial origin, yield fragmentary vertebrate remains. The following mammals have been identified from this horizon: *Felis*, near *atrox* Leidy; *Smilodon* ? sp.; *Mylodon* sp.; *Equus* sp. (possibly new); *Bison*, near *antiquus* Leidy; camelid (possibly new); *Elephas columbi* Falconer.

Remains of the ground-sloth from the Rodeo beds consist of parts of skeletal structures. The genus *Mylodon* is undoubtedly represented, but the materials are too incomplete for further determination.

Professor A. C. Lawson[b] has noted that, during the cutting of a tidewater canal at the east end of the city of Alameda, 13 feet of sand were exposed overlying 5 feet of the San Antonio formation (Pleistocene), in which occurred a femur and a pelvis of *Mylodon* (*Morotherium gigas*.).

On the San Francisco peninsula at least one occurrence of the genus *Mylodon* is now definitely known from available material. A humerus (No. 24242, U. C. C.) of this form was found at a depth of 60 feet, about 300 feet west of the intersection of Eighteenth Street and the Twin Peaks Tunnel, San Francisco. The specimen was obtained during the construction of the Twin Peaks Tunnel, and was presented to the Department of Palaeontology by Dr. L. W. Ely, of Palo Alto.

A second occurrence of ground-sloth remains on the peninsula is indicated in the following letter referred to Professor A. C. Lawson by Dr. C. D. Walcott:

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C., *June* 15, 1906.

Professor CHARLES D. WALCOTT,
U. S. National Museum, Washington, D. C.

DEAR SIR: In looking up some references to old volumes of the Proceedings of the California Academy of Science, I ran across an item which perhaps may be of interest from a palaeontological point of view. As the item is not indexed and might be easily overlooked, I venture to call your attention to it. It announces the discovery of Dr. C. F. Winslow in 1853 of a portion of a tibia which was pronounced by Professor Leidy to "belong to a gigantic sloth of an extinct and undetermined form." Both Professor Leidy and Professor Baird of the Smithsonian Institution took plaster casts of this tibia, the original of which was preserved by Dr. Winslow in Boston at the time of this report in 1876. Now this bone was found in digging a well, where Dr. Frederick Zeile's baths were afterwards located, in the rear of 524 to 528 Pacific Street, San Francisco, about the year 1852. The bone was found at a depth of 23 feet, and one of the workmen informed Dr. Winslow that the whole skeleton was still imbedded in the yellow silt through which the well was dug until water was reached. The skeleton was estimated to lie at a depth of 23 feet below the surface. "When Dr. Zeile's brick building was put up, Dr. Winslow observed that the rear wall just embraced the well within its area; and he has also considered it possible to reach the skeleton without injury to the edifice, by careful excavation. This gigantic fossil is probably entirely new to science, and would be of great value to the collections of the Academy."

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[a] C. Stock. The systematic position of the mylodont sloths from Rancho La Brea. Science, n. s., vol. 39, pp. 761–763, 1914.

[b] Geological Atlas of the United States, San Francisco Folio, No. 193, p. 15, 1914.

A considerable part of Pacific Street was burned down during the recent catastrophe in San Francisco, and if the building in question is among those that have been razed preparatory to reconstruction, there might be an excellent opportunity to secure the rest of the skeleton. Perhaps the effort was made to secure the skeleton sometime after 1875. All the information I have is from the Proceedings of the California Academy of Science, volume 6, for 1875, page 141.

I have written this thinking that perhaps the Museum presumably has a plaster cast of the tibia; it might be worth while to make some effort to secure the rest of the skeleton in the event that it has not yet been excavated.

Very truly yours,

WALTER F. SWINGLE,
Physiologist in Charge of Plant Life History.

The tibia discovered by Dr. Winslow and determined by Joseph Leidy may have belonged to *Mylodon*. No further information is known to the writer regarding the Pacific Street locality.

Sonoma County, California.—Mr. William McGrew, of Petaluma, California, discovered at a locality approximately a mile west and slightly south of the station of Stoney Point, a pelvis and several vertebrae of *Mylodon*. Stoney Point is 7 miles northwest of Petaluma. The ground-sloth remains occurred in a bluish clay with gravels of Pleistocene age, overlying unconformably a sandstone belonging probably to the Franciscan series (Jurassic?).

Marysville, California.—A fragmentary distal end of a right femur (No. 24245), presumably belonging to *Mylodon*, was presented to the Department of Palaeontology, University of California, by Dr. J. H. Barr, through Mr. I. C. Schumacher. The label attached to the specimen states that it was found on the ranch of N. S. Wilson, in an excavation caused by the flood of 1890. The locality is near Marysville, California. No. 24245 is comparable in size to the corresponding part in femora belonging to *Mylodon harlani* from Rancho La Brea. The articulating surfaces of the condyles are continuous with that for the patella, as in the femur of *Mylodon*. The width of the intercondyloid space is greater than in average specimens of *Mylodon harlani* from Rancho La Brea.

Point Conception, California.—A cervical vertebra, a rib fragment, and a complete fibula belonging to *Mylodon* were collected on a raised beach, 120 feet high, a mile north of Conception Station on the Southern Pacific Railroad. The specimens are now in the collections of the Museum of Palaeontology, University of California. The cervical vertebra (No. 11261) and the fibula (No. 11262) are comparable in size and shape to similar elements from the Rancho La Brea Pleistocene.

Eldorado County, California.—The presence of megalonychid ground-sloths in the Hawver Cave deposit has been already discussed (see pp. 115, 116). A first lower tooth and two phalanges belonging to *Mylodon harlani* were also found (Stock, 1918, pp. 489–491, figs. 7 to 10*b*). The mylodont ground-sloths probably encountered little difficulty in extending their range over the foothill belt, and their presence in deposits as at Hawver Cave should be expected where such accumulations were taking place during the Pleistocene, in fairly close proximity to the region of the Great Valley of California.

McKittrick, California.—Remains of mylodont ground-sloths have been found associated with other Pleistocene mammals in an asphalt deposit near McKittrick, on the southwest side of the San Joaquin Valley.[a] The forms so far recognized in the assemblage are listed below:

Aenocyon dirus (Leidy).	Arctotherium, near simum Cope.	Antilocapra? sp.
Canis, near ochropus Esch.	Taxidea sp.	Bison sp.
Felis atrox Leidy.	Mylodon? sp.	Camel, slender-limbed form.
Felis, near daggetti Merriam.	Equus occidentalis Leidy.	Mammut, near americanum (Kerr).

[a] J. C. Merriam and C. Stock. Occurrence of Pleistocene vertebrates in an asphalt deposit near McKittrick, California. Science, n. s., vol. 54, pp. 566–567, 1921.

A review of the fauna indicates several types, for example *Aenocyon dirus, Felis atrox, Equus occidentalis,* that are found also at Rancho La Brea. Striking differences between the two faunas are seen in the absence of the saber-tooth tiger at McKittrick and the presence of a slender-limbed camel generically distinct from the Rancho La Brea *Camelops* and closely related to *Lama.* The environment of the Great Valley of California seems to be suggested by the presence of the antelope. That conditions of life during the Pleistocene, in the region of McKittrick, were quite unlike those in the vicinity of Rancho La Brea seems entirely probable. This becomes evident also from a study of the Pleistocene birds of McKittrick, made by Dr. L. H. Miller. There appears to be some reason for interpreting the differences between the McKittrick and Rancho La Brea faunas on the basis of a time separation in the Pleistocene.

LITERATURE.

In the following list an attempt is made to include only the more specific references to the literature on the gravigrade edentates bearing particularly on the Megalonychinae and the Mylodontidae. References of more general nature are included in the text as footnotes.

Allen, G. M., 1913. A new Mylodon. Mem. Mus. Comp. Zool. Harv. Coll., vol. 40, pp. 319–346, 4 pls.

Ameghino, F., 1889. Contribucion al conocimiento de los Mammiferos fósiles de la Repúblico Argentina. Act. Acad. nac. de cienc. Córdoba, pp. 661–757, pls. 39–49.

———, 1899. Further remarks on *Neomylodon listai*. Proc. Zool. Soc. Lond., p. 830.

———, 1902. Notas sobre algunos mamiferos fosiles nuevos o poco conoeidos del valle de Tarija. An. Mus. Nac. Buenos Aires, ser. 3, vol. 1, pp. 225–261, 7 pls.

———, 1907. Notas sobre una pequena coleccion de huesos mamiferos procendentes de las grutas calcareas de Iporanga en el Estado de Sao Paulo-Brazil. Rev. Mus. Paulista, vol. 7, pp. 59–124.

Anthony, H. E., 1918. The indigenous land mammals of Porto Rico, living and extinct. Mem. Amer. Mus. Nat. Hist., vol. 2, pp. 331–435, pls. 55–75.

Boule, M., 1920. Mammifères fosiles de Tarija. With collaboration of A. Thévenin. (Mission scientifique G. de Créqui-Monfort et E. Sénéchal de la Grange.) H. le Soudier (Paris), Roy. 4to., pp. VII + 255.

Brown, B., 1903. A new genus of ground sloth from the Pleistoeene of Nebraska. Bull. Amer. Mus. Nat. Hist., vol. 19, pp. 569–583, pls. 50, 51.

Burmeister, H., 1864–1869. Lista de los mamiferos fosiles del terreno diluviano. An. Mus. Publ. Buenos Aires, vol. 1, p. 173, pl. 5, figs. 8*a*, 8*b*.

———, 1865. Hautpanzer bei Mylodon. Arch. f. Anat. Physiol. u. wissensch. Med., pp. 334–336.

———, 1879. Descriptive physique de la République Argentine d'apres des observations personnelles et étrangères. Vol. 3, Animaux vertébrés, pt. 1, mammifères vivants et eteints. Edentata, pp. 274–449.

———, 1881*a*. Bericht über ein Skelet von Scelidotherium leptocephalum. Monatsber. Akad. Wiss. Berlin, pp. 374–381, 1 pl.

———, 1881*b*. Atlas de la description physique de la République Argentine. Deuxieme section, mammifères. Dritte Abhandlung, Osteologie der Gravigraden oder Riesenfaulthiere, pp. 65–125, pls. 12–16.

———, 1882. Nothropus priscus, ein bisher unbekanntes fossiles Faulthier. Sitzber. k. preuss. Akad. Wiss. Berlin, pp. 613–620, pl. 11.

———, 1885. Berichtigung zu Coelodon. Sitzber. k. preuss. Akad. Wiss. Berlin, pp. 567–573, pl. 5.

———, 1886*a*. Weitere bemerkungen über Coelodon. Sitzber. k. preuss. Akad. Wiss. Berlin, pp. 357, 358.

———, 1886*b*. Nochmalige berichtigung zu Coelodon. *Ibid.*, pp. 1127–1132.

———, 1887. Neue beobachtungen von Coelodon. *Ibid.*, pp. 857–862.

Claypole, E. W., 1891. Megalonyx in Holmes County, Ohio, 1890. Amer. Geol., vol. 7, pp. 122–132; 149–153.

Cockerell, T. D. A., 1909. A fossil ground-sloth in Colorado. Univ. Colo. Studies, vol. 6, pp. 309–312, 2 pls.

Cope, E. D., 1871. Preliminary report on the vertebrata discovered in the Port Kennedy bone cave. Proc. Amer. Philos. Soc., vol. 12, pp. 73–102.

———, 1878. Deseriptions of new extinet vertebrata from the upper Tertiary and Dakota formations. Bull. U. S. Geol. and Geog. Surv. Terr., vol. 4, pp. 379–396.

———, 1880. Mylodon from Klamath River, near Yreka California. Amer. Nat., vol. 14, p. 62.

Cope. E. D., 1889. The Edentata of North Ameriea. Amer. Nat., vol. 23, pp. 657–664, pls. 31–32.

———, 1893. A preliminary report on the vertebrate paleontology of the Llano Estaeado. 4th Ann. Rept. Geol. Surv. Texas, 1892, 136 pp., 23 pls.

———, 1895. On some Pleistocene mammalia from Petite Anse, La. Proc. Amer. Philos. Soe., vol. 34, pp. 458–468, pls. 10–12.

———, 1899. Vertebrate remains from Port Kennedy bone deposit. Jour. Acad. Nat. Sci. Phila., ser. 2, vol. 11, pp. 193–267, pls. 18–21.

Cordovez, M., 1903. Los restos del Mylodon i la gruta de su nombre en la Patagonia occidental. Actas Soc. cient. Chile, vol. 12, pp. 1–19, 2 pls.

Eaton, G. F., 1914. Vertebrate fossils from Ayusbamba, Peru. Amer. Jour. Sci., ser. 4, vol. 37, pp. 141–154, pls. 5, 6, and 7.

Flower, W. H., 1882 On the mutual affinities of the animals composing the order Edentata. Proc. Zool. Soc. Lond., pp. 358–367.

Gervais, H., and F. Ameghino, 1880. Les mammifères fossiles de L'Amérique du Sud. Paris and Buenos Aires, 225 pp.

Gervais, P., 1855. Reeherches sur les mammifères fossiles de l'Amérique méridionale. Extrait de la Zoologie de l'Expédition dans les parties eentrales de l'Amérique du Sud, publiée sous la direction de M. le comte François de Castelnau. Paris, 64 pp., 13 pls.

———, 1869. Mémoire sur les formes cérébrales propres aux Édentés vivants et fossiles. Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 5, pp. 1–56, pls. 1–5.

———, 1873. Mémoire sur plusieurs espèees de mammifères fossiles propres à l'Amérique méridionale. Mém. Soc. Géol. France, ser. 2, vol. 9, 44 pp., pls. 21–29.

Harlan, R., 1825. Fauna Americana: being a description of the mammiferous animals inhabiting North America. pp. 199–203.

———, 1835. Medical and physical researches. pp. 271–275; 314–318; 319–333; 334–336; 336; pls. 12–15, 16.

———, 1843. Description of the bones of a new fossil animal of the order Edentata. Amer. Jour. Sci., ser. 1, vol. 44, pp. 69–80, 3 pls.

Hauthal, R., 1900*a*. Die haustiereigensehaft des *Grypotherium domesticum* Roth, die glacialverhältnisse bei Ultima Esperanza und die berechtigung des namens *Grypotherium domesticum*. Globus, vol. 78, pp. 333–338; 357–360.

———, 1900*b*. Quelques rectifieations relatives au *Grypotherium* de la caverne Eberhardt. Comunicaciones del Mus. Nae. Buenos Aires, vol. 1, pp. 241–252.

———, 1904. Die bedeutung der funde in der Grypotheriumhöhle bei Ultima Esperanza (südwestpatagonien). Ber. Senkenb. Naturf. Ges. Frankfurt a. M., pp. 89–91, Dec. 12, 1903.

Hauthal, R., S. Roth, and R. Lehmann-Nitsche. 1899. El mamifero misterioso de la Patagonia "Grypotherium domesticum." Rev. Mus. de la Plata, vol. 9, pp. 409–473, 5 pls.

Hay, O. P., 1916. Descriptions of two extinct mammals of the order Xenarthra from the Pleistoeene of of Texas. Proc. U. S. Nat. Mus., vol. 51, pp. 107–123, pls. 3–7.

———, 1919. Deseriptions of some mammalian and fish remains from Florida of probably Pleistoeene age. Proe. U. S. Nat. Mus., vol. 56, pp. 103–112, pls, 26–28.

HOLMES, F. S., 1858. Remains of domestic animals among fossils in South Carolina. Charleston, S. C., 16 pp. (Reviewed in Amer. Jour. Sci., ser. 2, vol. 25, pp. 442–443.)

JACOB, C., 1902. Examen mieroscopico de in pieza cutanea del mamifero misterioso de la Patagonia "*Grypotherium domesticum*." Rev. Mus. de la Plata, vol. 10, pp. 61–62, 1 pl.

———, 1911. Vom tierhirn zum menschenhirn. Vergleichend morphologische, histologische u. biologische studien zur entwicklung der grosshirnhemisphären und ihre rinde.

JEFFERSON, T., 1799. A memoir on the discovery of certain bones of a quadruped of the clawed kind in the western parts of Virginia. Trans. Amer. Philos. Soc., vol. 4, pp. 246–260.

KRAGLIEVICH, L., 1921*a*. Descripcion comparativa del genero Pleurolestodon. Rev. Mus. Nac. Buenos Aires, vol. 31, pp. 95–118.

———, 1921. Estudios sobre los Mylodontinae. Descripcion del cranes y mandibula del Pseudolestodon myloides gallenii, n. sbsp. An. Mus. Nac. Buenos Aires, vol. 31, pp. 119–134.

———, 1922. Estudios sobre los Mylodontinae. Análisis comparado de los valores cráneométriços de los Milodontinos de Norte y Sud América. An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 31, pp. 457–464.

LE CONTE, J., 1882. On certain remarkable tracks, found in the rocks of Carson quarry. Proc. Calif. Acad. Sci., Aug. 27, 10 pp.

———, 1883. Carson footprints, a letter to Nature. Nature, vol. 28, pp. 101–102.

LEHMANN-NITSCHE, R., 1902. Die gleichzeitigkeit der südpatagonischen hohlenbewohner mit dem *Grypotherium* und anderen ausgestorbenen thieren der argentinischen hohlenfauna. Arch. Anthrop. Braunschweig, vol. 27.

LEIDY, J., 1855. A memoir on the extinct sloth tribe of North America. Smithson. Contrib. Knowl., vol. 7, 68 pp., 16 pls.

———, 1860. Remarks on the structure of the feet of Megalonyx. Trans. Amer. Philos. Soc., n. s., vol. 11, p. 107, pl. 6.

———, 1868. Notice of some vertebrate remains from the West Indian Islands. Proc. Acad. Nat. Sci. Phila., vol. 20, pp. 178–180.

———, 1870. Remarks on Mylodon? robustus, from Central America, and on Dromatherium sylvestre. Proc. Acad. Nat. Sci. Phila., vol. 22, pp. 8–9.

———, 1885. Remarks on Mylodon. Proc. Acad. Nat. Sci. Phila., vol. 37, pp. 49–51.

———, 1889. Notice of some mammalian remains from the salt mine of Petite Anse, La. Trans. Wag. Free Inst. Sci., vol. 2, pp. 33–40.

LINDAHL, J, 1892. Description of a skull of Megalonyx leidyi, n. sp. Trans. Amer. Philos. Soc., vol. 17, pp. 1–10, pls. 1–5.

LOOMIS, F. B., 1914. The Deseado formation of Patagonia. Concord, 232 pp.

LÖNNBERG, E., 1899. On some remains of "Neomylodon listai" Ameghino brought home by the Swedish expedition to Tierra del Fuego 1896. Wissensch. Ergebn. Schwedish. Exped. Magellansländ. 1895–1897 unter leitung von Dr. Otto Nordenskjöld, vol. 2, pp. 149–170, pls. 12–14.

LULL, R. S., 1915. A Pleistocene ground sloth, Mylodon harlani, from Rock Creek, Texas. Amer. Jour. Sci., ser. 4, vol. 39, pp. 327–385.

LUND, P. W., 1836. Om huler i kalksteen i det sudre af Brazilien, der tildeels ondeholde fossile knokler. Kgl. Danske Vidensk. Selsk. Naturwidenskabelig. og math. 1 Afd., 6 deel, pp. 209–249, pls. 1 and 2.

———, 1839. Recherches sur les mammifères fossiles du Brésil. Ann. Sci. Natur., ser. 2 (Zool), vol. 11, p. 220.

———, 1842. Blik paa Braziliens dyreverden för sidste jordomvaeltning. Kgl. Dansk. Vid. Selsk, Skr., 4 Raekke, 9 deel, pp. 137–208, pls. 28–38.

LUTKEN, C., 1886. Antikritiske bemaerkninger i anledning af kaempledovendyrslaegten Coelodon. Oversiggt K. Danske Selsk. Forhandl., pp. 78–84.

LYDEKKER, R., 1886. Description of three species of Scelidotherium. Proc. Zool. Soc. Lond., pp. 491–498, pls. 46–49.

———, 1894. Contributions to a knowledge of the fossil vertebrates of Argentina. Pt. 2: Extinct edentates of Argentina. An. Mus. de la Plata, Paleontologia Argentina, pt. 3, 103 pp., 69 pls.

MARSH, O. C., 1874. Notice of new Tertiary mammals. Amer. Jour. Sci., ser. 3, vol. 7, pp. 531–532.

———, 1883. On the supposed human foot-prints recently found in Nevada. Amer. Jour. Sci., ser. 3, vol. 26, pp. 139–140.

———, 1897. The Stylinodontia, a suborder of Eocene edentates. Amer. Jour. Sci., ser. 4, vol. 3, pp. 137–146.

MATTHEW, W. D., 1911. The ground-sloth group. Amer. Mus. Jour., vol. 11, pp. 113–119.

———, 1912. Ancestry of the edentates. Amer. Mus. Jour., vol. 12, pp. 300–303.

———, 1915. Climate and evolution. Ann. N. Y. Acad. Sci., vol. 24, pp. 259–262.

———, 1919. Recent discoveries of fossil vertebrates in the West Indies and their bearing on the origin of the Antillean fauna. Proc. Amer. Philos. Soc., vol. 58, pp. 161–181.

MERRIAM, J. C., 1899. Ground-sloths in the California Quaternary. Bull. Geol. Soc. Amer., vol. 11, pp. 612–614, pl. 58.

———, 1900. On the occurrence of ground-sloths in the Quaternary of middle California. Science, n. s., vol. 11, p. 219.

———, 1906. Recent discoveries of Quaternary mammals in southern California. Science, n. s., vol. 24, pp. 248–250.

MORENO, F. P., 1899. On a portion of mammalian skin, named *Neomylodon listai*, from a cavern near Consuelo Cove, Last Hope Inlet, Patagonia. Proc. Zool. Soc. Lond., pp. 144–148.

NORDENSKIOLD, E., 1899. Neue untersuchungen über Neomylodon listai (vorläufige mittheilung). Zool. Anz., vol. 22, pp. 335–336.

———, 1900. Iakttagelser och fynd grottor vid Ultima Esperanza i sydvestra Patagonien. Kongl. Svenska Vetensk.-Akad. Handl., Stockholm., vol. 33, 24 pp., 7 pls.

———, 1901. Über die säugethierfossilien im Tarijathal, Südamerika. Bull. Geol. Instit. Univ. Upsala, vol. 5, pp. 261–266.

———, 1908. Ein neuer fundort für säugetierfossilien in Peru. Arkiv for Zoologi, vol. 4, 22 pp., 2 pls.

OSBORN, H. F., 1910. The age of mammals in Europe, Asia, and North America. N. Y., xvii + 635 pp.

OWEN, R., 1840. The zoology of the voyage of H. M. S. Beagle, 1832–36. Pt. 1, Fossil Mammalia, Lond., pp. 73–99, pls. 20–28.

———, 1842. Description of the skeleton of an extinct gigantic sloth, *Mylodon robustus* Owen, with observations on the osteology, natural affinities, and probable habits of the megatherioid quadrupeds in general. London, 176 pp., 24 pls.

———, 1843. Letter from Richard Owen, esq., F. R. S., F. G. S., etc., etc., on Dr. Harlan's notice of new fossil mammalia. (Letter dated 1842). Amer. Jour. Sci., ser. 1, vol. 44, pp. 341–345.

———, 1857. On the scelidothere (Scelidotherium leptocephalum Owen). Phil. Trans. Roy. Soc. Lond., vol. 147, pp. 101–110, pls. 8–9.

PERKINS, H. C., 1842. Notice of fossil bones from Oregon Territory, in a letter to Dr. C. T. Jackson. Amer. Jour. Sci., ser. 1, vol. 42, pp. 136–140.

PHILIPPI, R. A., 1893. Vorläufige nachricht über fossile säugethierknochen von Ulloma, Bolivia. Zeitschrift deutsch. Geol. Ges.. vol. 45. pp. 87–96.

PHILIPPI, R. A., 1900. Contribucion à la ostéolojia del Grypotherium domesticum Roth i un neuvo delfin. Anal. de la Univ. de Chile, vol. 107, pp. 105–114, 4 pls.

———, 1901. Beiträge zur kenntniss der knochen des *Grypotherium domesticum* Roth. Arch. f. naturgesch., 67, vol. 1, pp. 271–275, pl. 15.

POUCHET, G., 1868–1869. Memoire sur l'encéphale des Édentés. Jour. de l'anatomie et de la physiologie, vol. 5, 1868, pp. 658–675; vol. 6, 1869, pp. 1–18, 147–162, 302–316, 349–363, pls. 1–6.

RAUTENBERG, M., 1906. Über Pseudolestodon hexaspondylus. Palaeontographica, vol. 53, pp. 1–50, pls. 1–6.

REINHARDT, J., 1866. Ueber den hautpanzer der megatheroiden thiere. Arch. Anat. Physiol. u. wissensch. Med., pp. 414–415.

———, 1875. Bidrag til kundskab om kjaempodovendyret Lestodon armatus. Vidensk. Selsk. Skr., 5 Raekke, naturvidenskabelig og mathematisk Afd., vol. 11, pp. 1–38, 3 pls.

———, 1878. Kaempedovendyr-Slaegten Coelodon. Vidensk, Selsk, Skr., 5 Raekke, naturvidenskabelig og mathematisk Afd., vol. 12, pp. 257–335, 5 pls.

———, 1879. Beskrivelse af Hovedskallen af et Kaempedovendyr, *Grypotherium darwinii*, fra La Plata-Landenes pleistocene Dannelser. Vidensk. Selsk. Skr., 5 Raekke, naturvidenskabelig og mathematisk Afd., vol. 12, pp. 351–380, 2 pls.

RICHTERS, F., 1904. Mikr. untersuchung von Grypotherium - Dung. Ber. Senckenb. Naturf. Ges. Frankfurt a. M., p. 46.

RIDEWOOD, W. C., 1901. On the structure of the hairs of *Mylodon listai* and other South American Edentata. Quart. Jour. Micros. Sci., vol. 44, n. s., pp. 393–411, pl. 26.

ROVERETO, C., 1914. Los Estratas Araucanos y sus fosiles. Anal. Mus. Nac. Hist. Nat. Buenos Aires, vol. 25, 249 pp., 31 pls.

SAFFORD, J. M., 1892. The pelvis of a *Megalonyx* and other bones from Big Bone Cave, Tennessee. Bull. Geol. Soc. Amer., vol. 3, pp. 121–123.

SCOTT, W. B., 1903–04. Reports of the Princeton University expeditions to Patagonia, 1896–1899, J. B. Hatcher in charge. Vol. 5, Palaeontology, Mammalia of the Santa Cruz beds. pp. 161–364, pls. 30–63.

———, 1913. A history of land mammals in the western hemisphere. xiv + 693 pp., 32 pls.

SEFVE, I., 1915*a*. Über einen Scelidotherium-Schädel aus Tarija, Bolivia. Kongl. Svenska Vetensk.-Akad. Handl., Stockholm, vol. 53, 12 pp., 2 pls.

———, 1915*b*. Scelidotherium-Reste aus Ulloma, Bolivia. Bull. Geol. Instit. Univ. Upsala, vol. 13, pp. 61–92, pls. 10 and 14.

SCHULTHESS, B., 1920. Beiträge zur kenntnis der Xenarthra auf grund der "Santiago Roth'schen sammlung" des zoologischen museums der Universität Zürich. Mem. Soc. Pale. Suisse, vol. 44, 119 pp., 6 pls.

SINCLAIR, W. J., 1905. New mammalia from the Quaternary caves of California. Univ. Calif. Publ., Bull. Dept. Geol., vol. 4, pp. 145–161, pls. 19–23.

———, 1906. Some edentate-like remains from the Mascall beds of Oregon. *Ibid.*, vol. 5, pp. 65–66.

———, 1910. Dermal bones of *Paramylodon* from the asphaltum deposits of Rancho La Brea, near Los Angeles, California. Proc. Amer. Philos. Soc., vol. 49, pp. 191–195.

STOCK, C., 1913. Nothrotherium and Megalonyx from the Pleistocene of southern California. Univ. Calif Publ. Bull. Dept. Geol., vol. 7, pp. 341–358.

———, 1914. Skull and dentition of the mylodont sloths of Rancho La Brea. *Ibid.*, vol. 8, pp. 319–334.

———, 1917*a*. Recent studies on the skull and dentition of Nothrotherium from Rancho La Brea. *Ibid.*, vol. 10, pp. 137–164.

———, 1917*b*. Further observations on the skull structure of mylodont sloths from Rancho La Brea. *Ibid.*, vol. 10, pp. 165–178, pls. 3–4.

———, 1917*c*. Structure of the pes in Mylodon harlani. *Ibid.*, vol. 10, pp. 267–286.

———, 1918. The Pleistocene fauna of Hawver Cave. *Ibid.*, vol. 10, pp. 461–515.

———, 1920*a*. Origin of the supposed human footprints of Carson City, Nevada. Science, n. s., vol. 51, p. 514.

———, 1920*b*. A mounted skeleton of Mylodon harlani. Univ. Calif. Publ. Bull. Dept. Geol., vol. 12, pp. 425–430, pl. 51.

STUDER, T., 1905. Ueber neue funde von *Grypotherium listai* Amegh, in der Eberhards höhle von Ultima Experanza. Neue Denkschr. allg. schweiz. Ges. Nat., vol. 40, pp. 1–18, pls. 1–3.

WINGE, H., 1915. Jordfundne og nulevende Gumlere (*Edentata*) fra Lagoa Santa, Minas Geraes, Brasilien. Med Udsigt over Gumlernes indbyrdes Slaegtskab. E Museo Lundii, vol. 3, pt. 2, 321 pp. 42 pls.

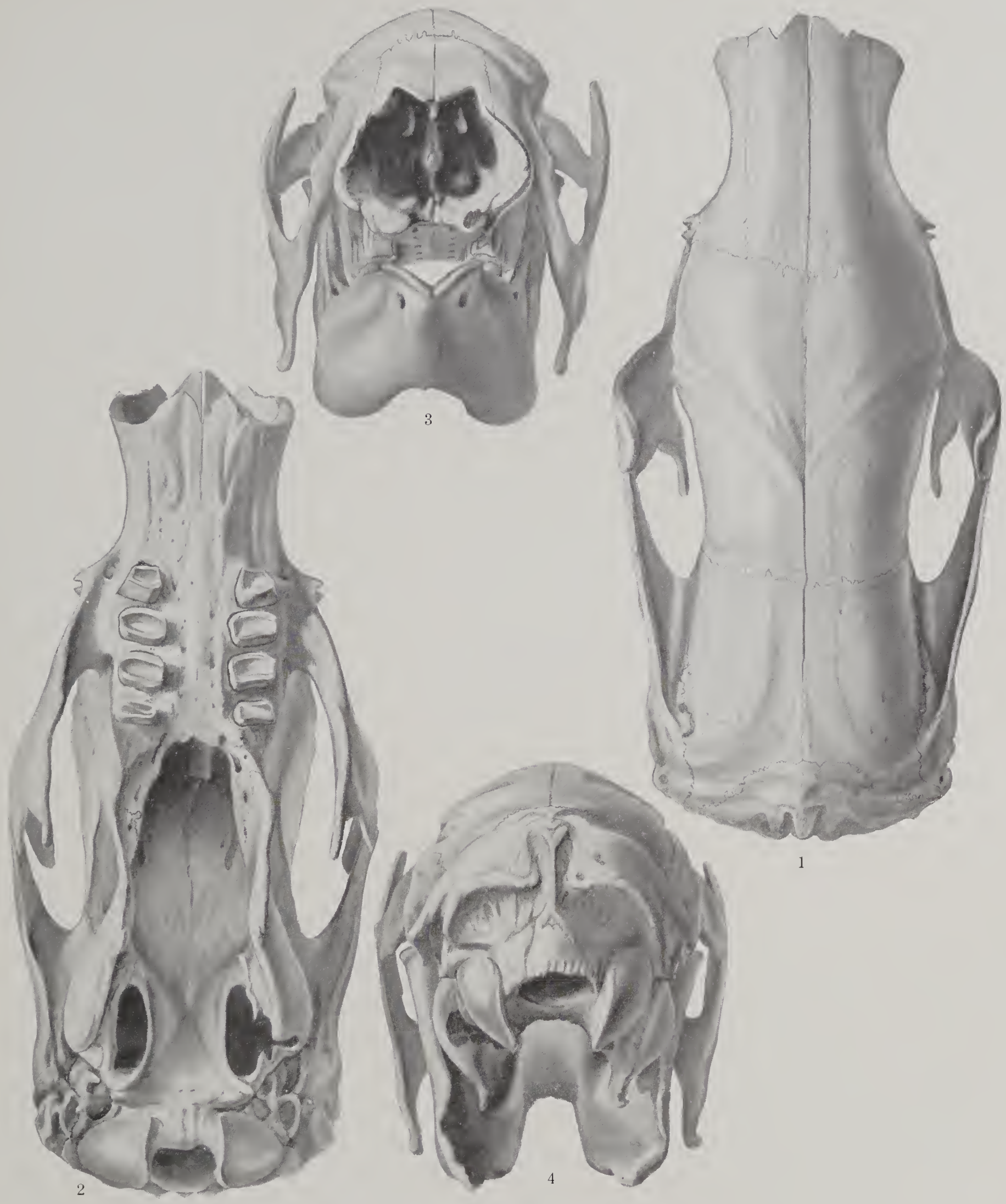
WOODWARD, A. S., 1899. On a portion of mammalian skin, named *Neomylodon listai*, from a cavern near Consuelo Cove, Last Hope Inlet, Patagonia. With a description of the specimen. Proc. Zool. Soc. Lond., pp. 148–156, pls. 13–15.

———, 1900. On some remains of *Grypotherium* (*Neomylodon*) *listai* and associated mammals from a cavern near Consuelo Cove, Last Hope Inlet, Patagonia. Proc. Zool. Soc. Lond., pp. 64–79, pls. 5–9.

WYMAN, L. E., 1922. Notes on the Pleistocene fossils obtained from Rancho La Brea asphalt pits. Los Angeles Museum, Misc. Publ. No. 2, 35 pp., illust.

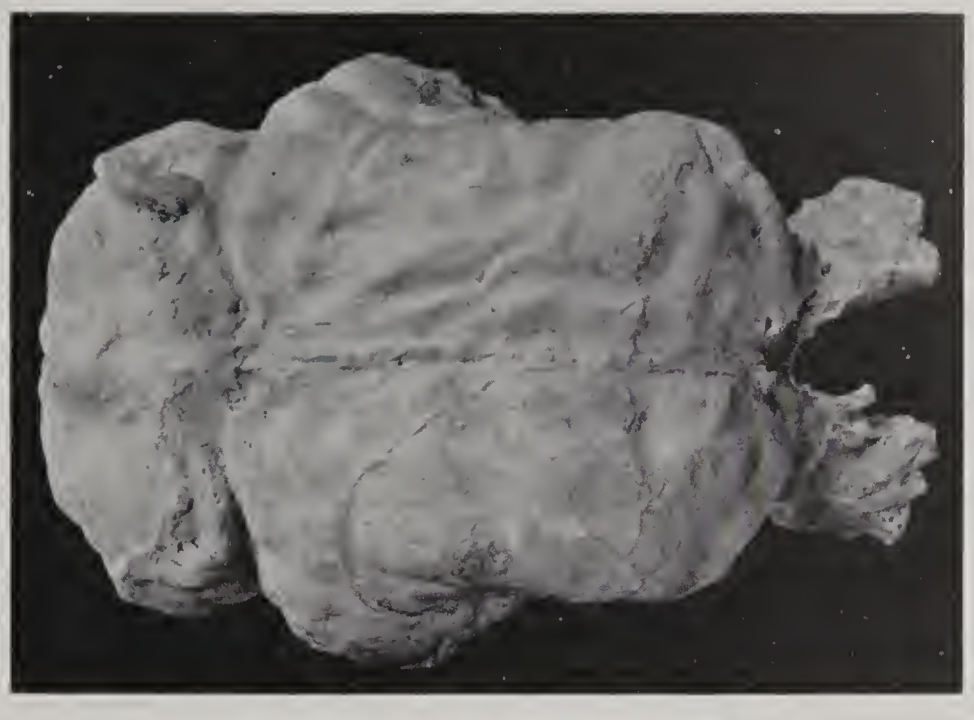
View looking north, showing Los Angeles Museum Pits 61 and 67, Rancho La Brea. Photograph by L. E. Wyman. Courtesy of Los Angeles Museum.

View looking northeast, showing final stage in removal of wall separating Los Angeles Museum Pits 61 and 67, Rancho La Brea. Photograph by L. E. Wyman. Courtesy of Los Angeles Museum.



Nothrotherium shastense Sinclair.

FIGS. 1 and 2. Skull, No. 1800–11, dorsal and ventral views. × 0.44.
FIGS. 3 and 4. Skull and mandible, No. 1800–11 and No. 1801–7, anterior and posterior views. × 0.44.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.



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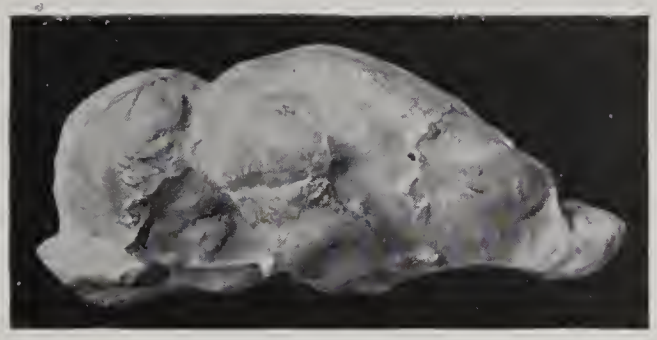

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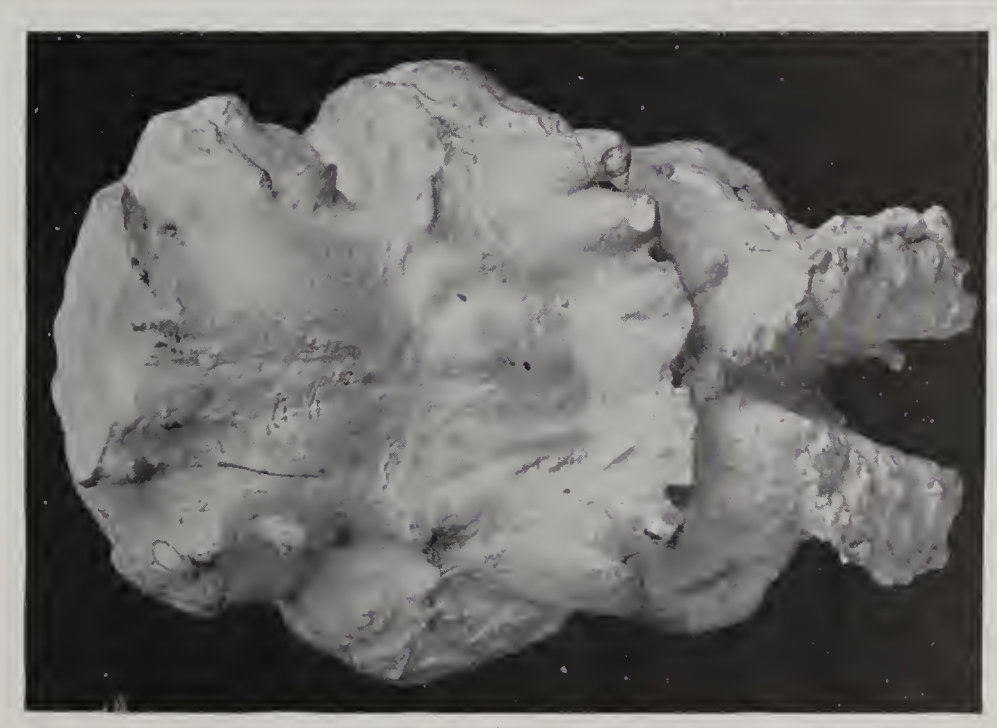

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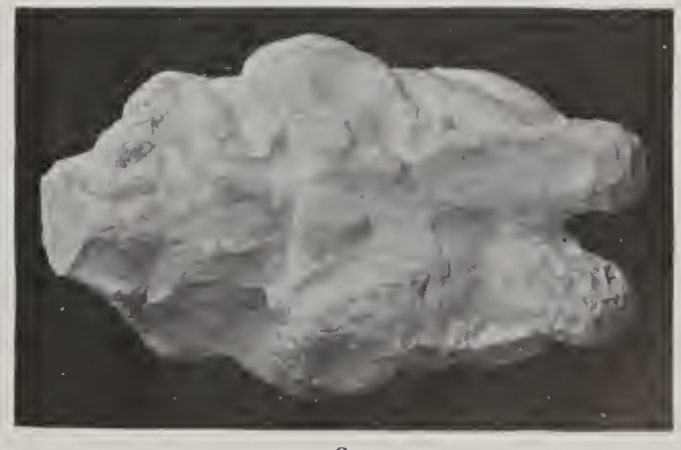

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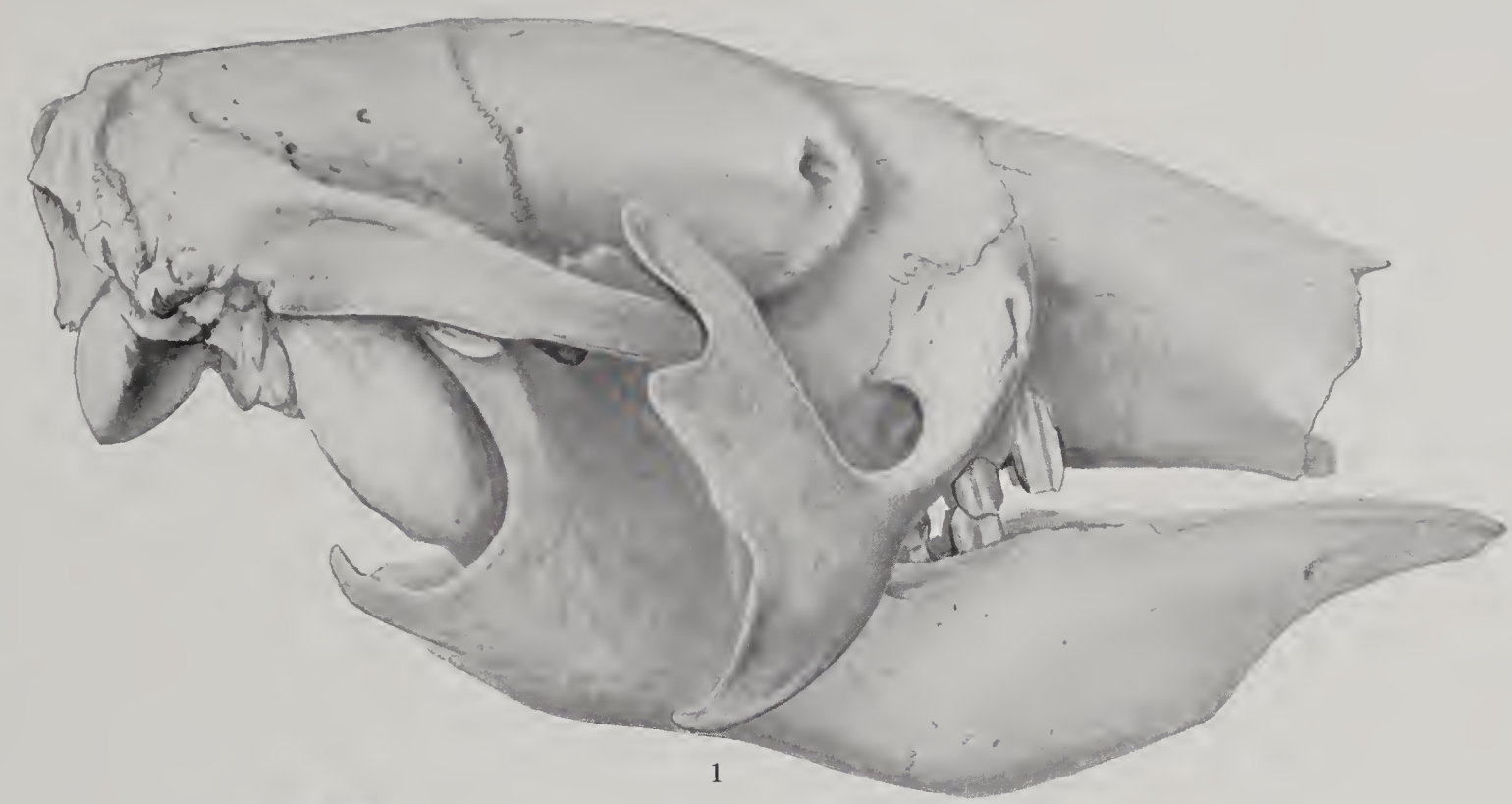
Nothrotherium shastense Sinclair.

FIGS. 1, 2, and 3. Endocranial cast. Fig. 1, dorsal view; Fig. 2, lateral view; Fig. 3, ventral view. × 0.75.

Hapalops sp.

FIGS. 4, 5, and 6. Endocranial cast. Fig. 4, dorsal view; Fig. 5, lateral view; Fig. 6, ventral view. × 0.75.
Los Angeles Museum Collection.



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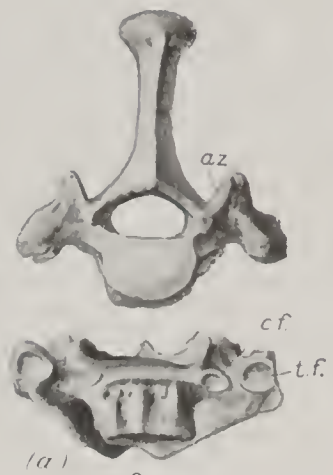
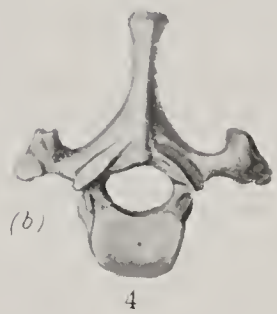
Nothrotherium shastense Sinclair.

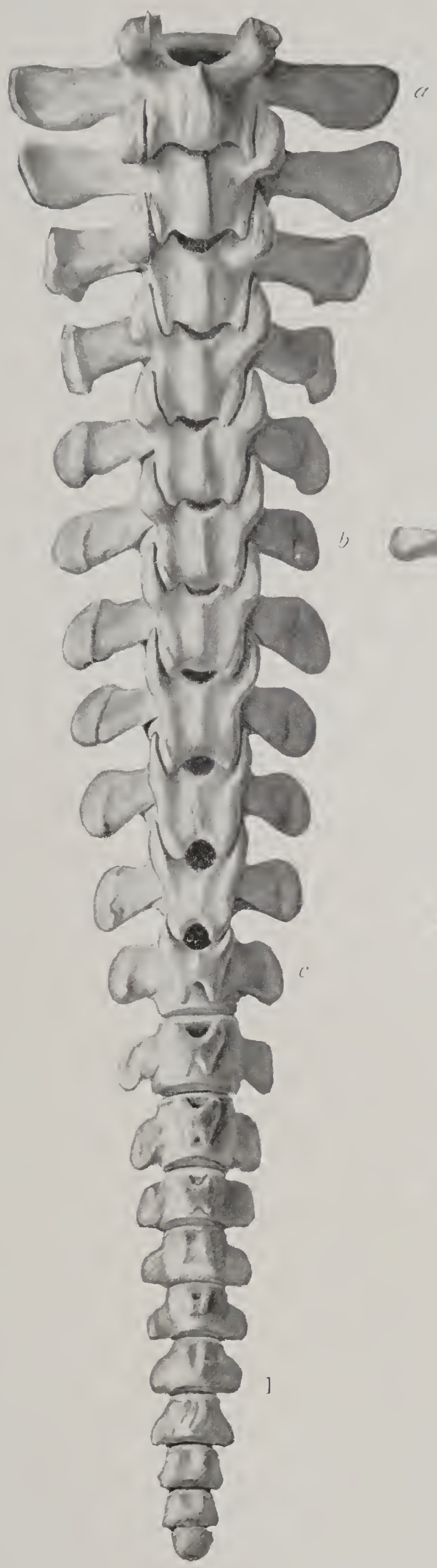
Fig. 1. Skull and mandible, No. 1800–11 and No. 1801–7, lateral view. × 0.44.
Fig. 2. Mandible, No. 1801–7, dorsal view. × 0.44.
Figs. 3 and 4. Cervical vertebrae I–VII inclusive, lateral and dorsal views. × 0.25.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.





Nothrotherium shastense Sinclair.

FIGS. 1 and 2. Thoracic and lumbar vertebrae, dorsal and lateral views. × 0.25.
FIG. 3. First thoracic vertebra, No. 1809–1, anterior and ventral views. × 0.25. *az*, anterior zygapophysis; *c.f.*, facet for capitulum of rib; *tf.*, facet for tuberculum of rib.
FIG. 4. Third thoracic vertebra, No. 1811–1, anterior view. × 0.25.
FIG. 5. Last thoracic vertebra, No. 1825–1, anterior view. × 0.25.
FIG. 6. First lumbar vertebra, No. 1826–1, anterior view. × 0.25.
FIG. 7. Third lumbar vertebra, No. 1828–1, anterior view. × 0.25.



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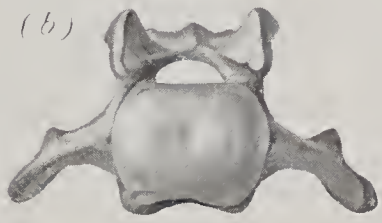

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Nothrotherium shastense Sinclair.

FIGS. 1 and 2. Caudal vertebrae, dorsal and lateral views. × 0.25.
FIG. 3. First caudal vertebra, No. 1830–1, anterior view. × 0.25.
FIG. 4. Sixth caudal vertebra, No. 1835–1, anterior view. × 0.25.
FIG. 5. Eleventh caudal vertebra, No. 1840–1, anterior view. × 0.25.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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Nothrotherium shastense Sinclair.

Fig. 1. Sternal segments and sternal ribs, ventral view. × 0.33. I and VI, first and sixth sternal elements; II (?) and VIII, sternal ribs.

Fig. 2. Costal ribs, posterior view. × 0.33. I, VI, X, XIII, XVII, first costal rib fused with first sternal rib, sixth, tenth, thirteenth, seventeenth costal ribs.

Los Angeles Museum Collection. Rancho La Brea Pleistocene.

Nothrotherium shastense Sinclair.

Figs. 1, 1*a*. Right humerus, No. 1874–R–1. Fig. 1, anterior view; Fig. 1*a*, view of distal end. × 0.50.
Figs. 2, 2*a*. Right humerus, No. 1874–R–1. Fig. 2, inner view; Fig. 2*a*, view of proximal end. × 0.50.
Figs. 3, 3*a*. Right scapula, No. 1868–R–2. Fig. 3, outer view; Fig. 3*a*, view of proximal end. × 0.25.
Fig. 4. Right clavicle, No. 1878–R–2, anterior view. × 0.50.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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Nothrotherium shastense Sinclair.

FIGS. 1, 2 and 3. Left ulna, No. 1873 L. 1. Fig. 1, inner view; Fig. 2, outer view; Fig. 3, radial view. × 0.50.
FIGS. 4 and 5. Left radius without distal epiphysis, No. 1872 L. 1. Fig. 4, anterior view; Fig. 5, inner view. × 0.50.
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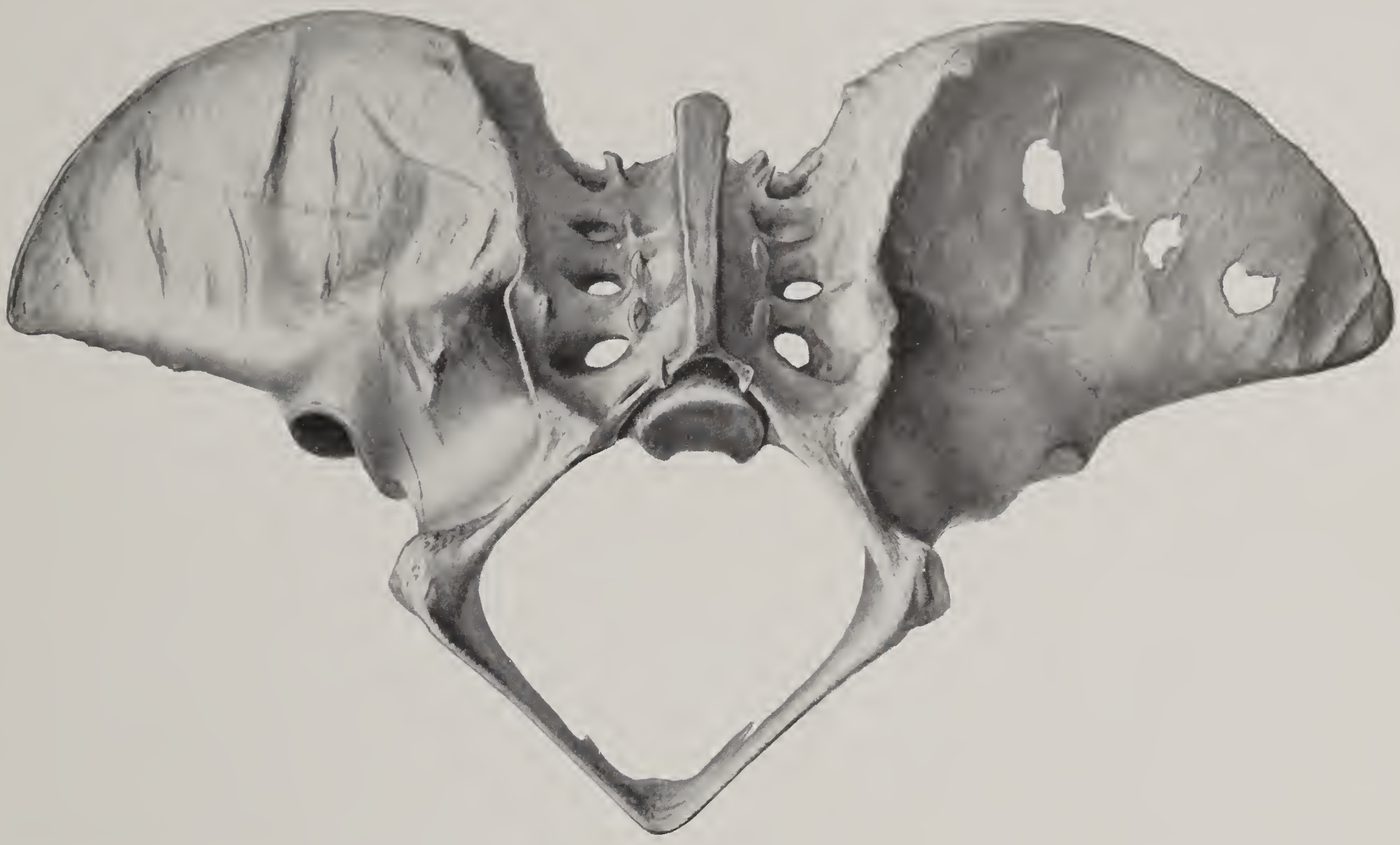

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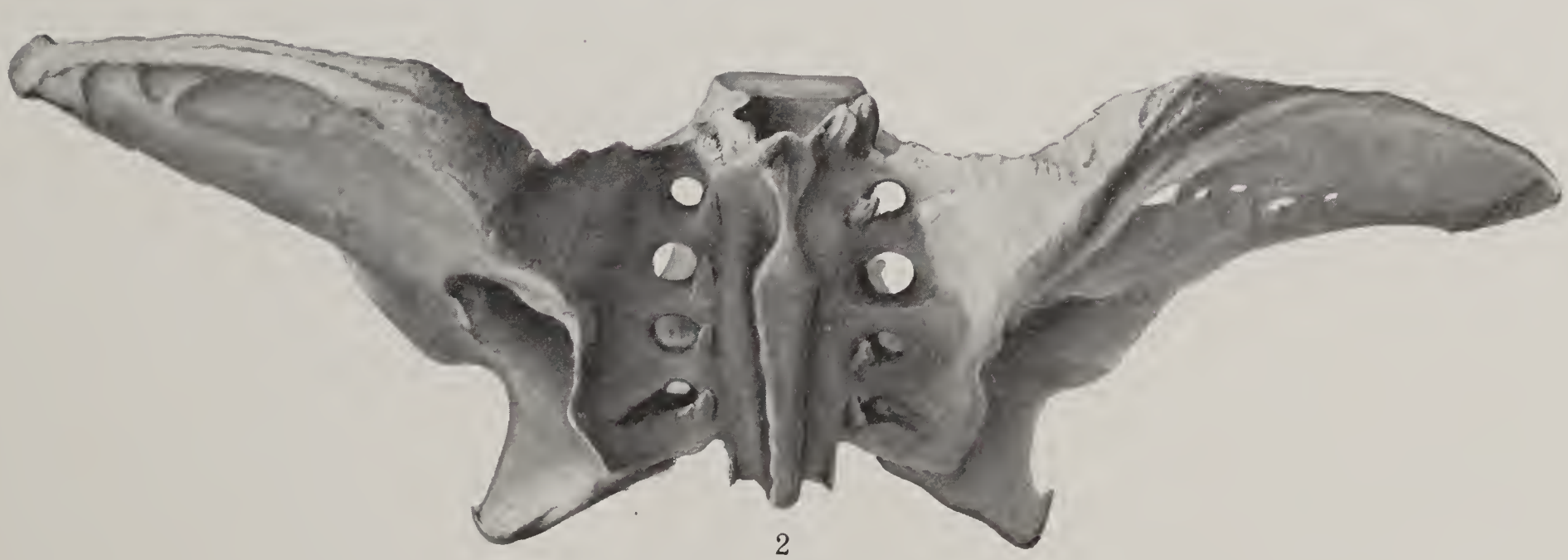

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Nothrotherium shastense Sinclair.

FIGS. 1 and 2. Pelvis, No. 1892–1. Fig. 1, posterior view; Fig. 2, dorsal view. × 0.22.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

Nothrotherium shastense Sinclair.

FIGS. 1 and 2. Pelvis, No. 1892–1. Fig. 1, lateral view; Fig. 2, anterior view. × 0.22.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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Nothrotherium shastense Sinclair.

FIGS. 1, 1*a*, and 1*b*. Left femur, No. 1871–L–1. Fig. 1, anterior view; Fig. 1*a*, view of proximal end; Fig. 1*b*, view of distal end. × 0.50.
FIGS. 2 and 3. Left patella, No. 1895–L–1. Fig. 2, femoral view; Fig. 3, anterior view. × 0.50.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

Nothrotherium shastense Sinclair.

FIGS. 1 and 2. Left femur, No. 1871–L–1. Fig. 1, posterior view; Fig. 2, inner view. × 0.50. Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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Nothrotherium shastense Sinclair.

FIGS. 1, 1*a*, and 1*b*. Right tibia, No. 1870–R–1. Fig. 1, anterior view; Fig. 1*a*, view of proximal end; Fig. 1*b*, view of distal end. × 0.50.

FIG. 2. Right tibia, No. 1870–R–1, inner view. × 0.50.

FIG. 3. Right fibula, No. 1869–R–1, tibial view. × 0.50.

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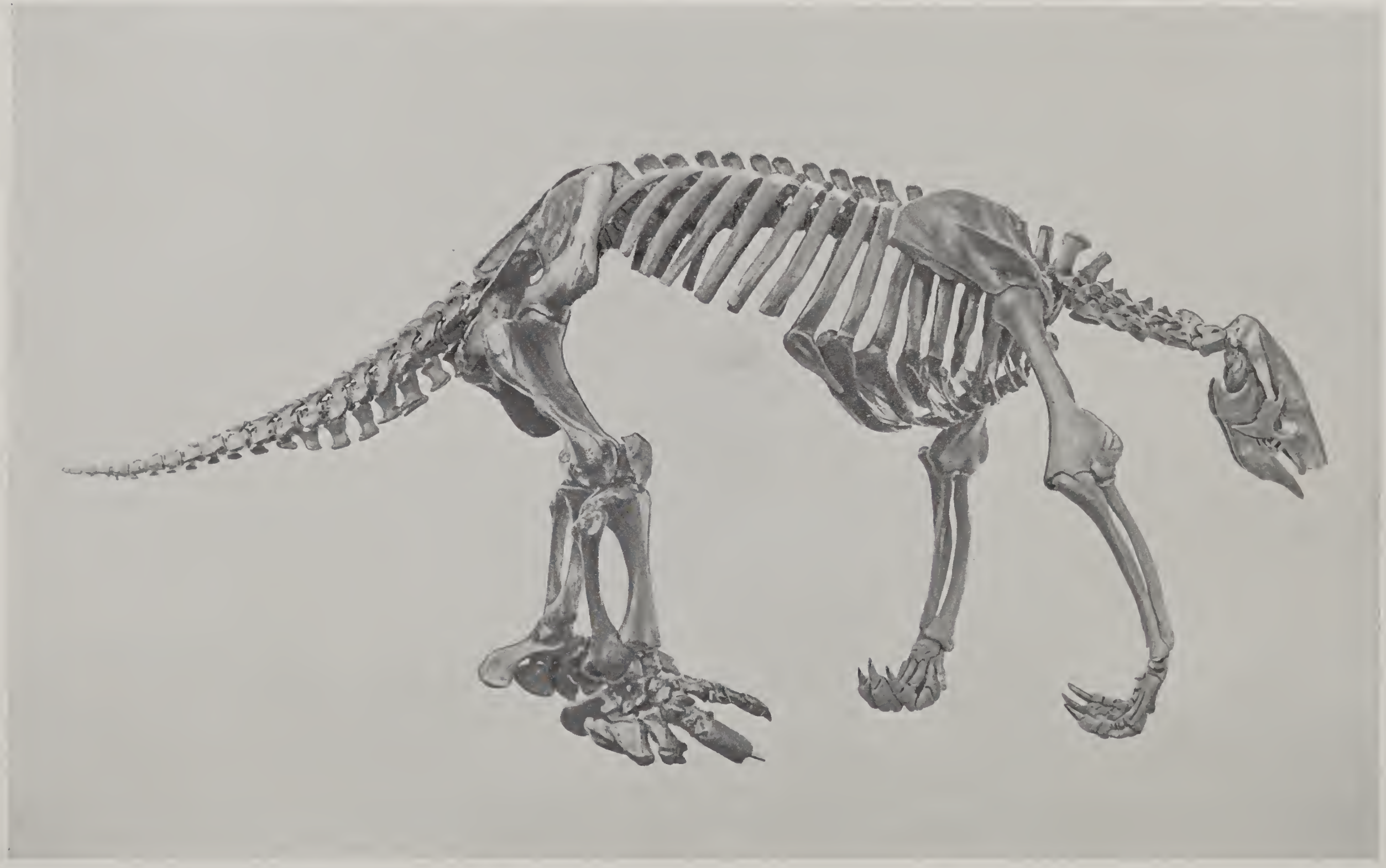
Nothrotherium shastense Sinclair.

FIGS. 1 and 2. Right pes. Fig. 1, dorsal view. Fig. 2, inner view. × 0.50.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.



Nothrotherium shastense Sinclair.

Mounted skeleton, viewed from right side. × 0.094. Los Angeles Museum Collection. Prepared by J. W. Lytle. Photograph by L. E. Wyman. Courtesy of Los Angeles Museum.

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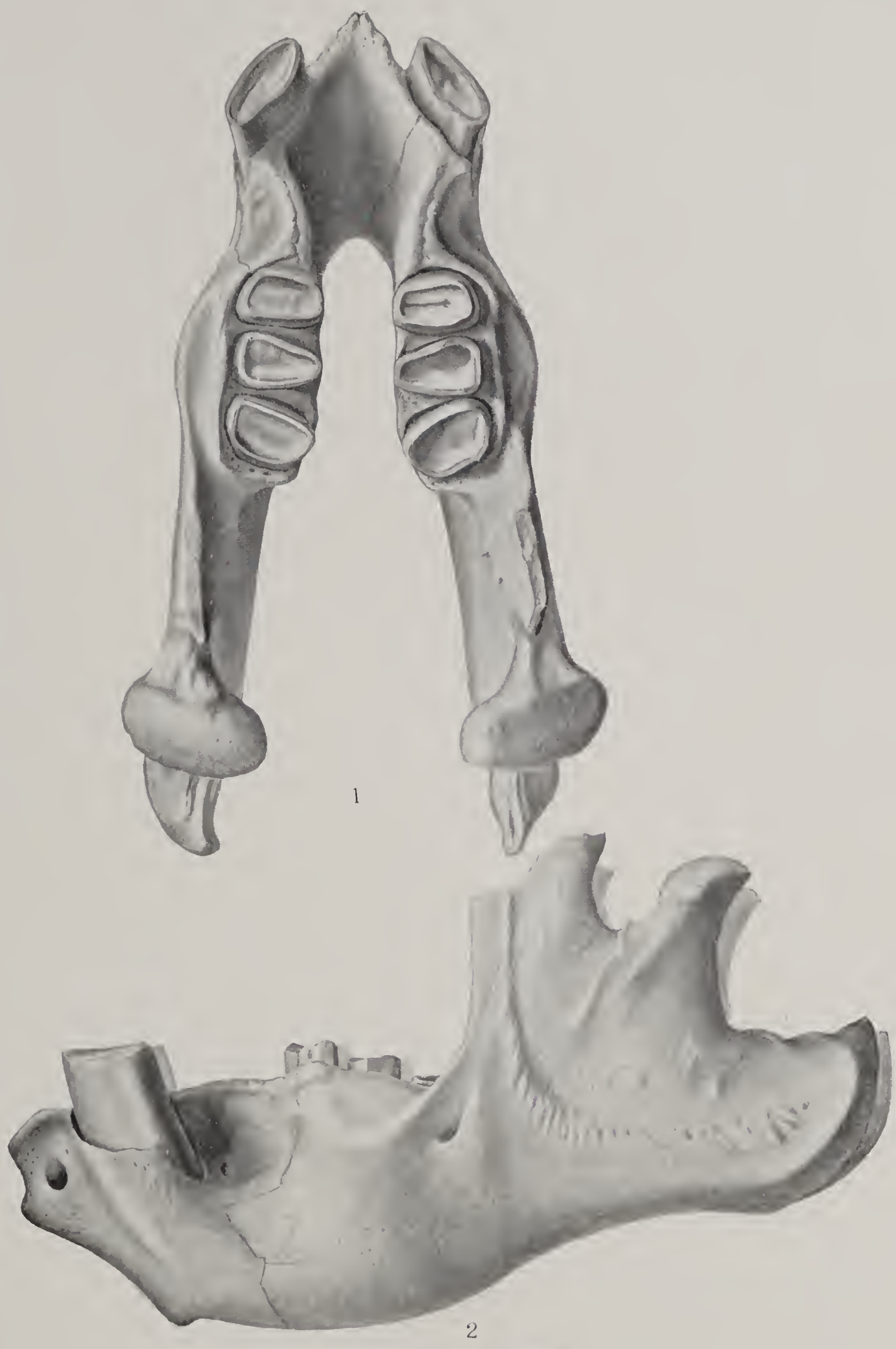

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Megalonyx jeffersonii californicus Stock.

FIGS. 1 and 2. Mandible, No. 21429. Fig. 1, dorsal view; Fig. 2, view of left side. × 0.50. University of California Collection. Rancho La Brea Pleistocene.

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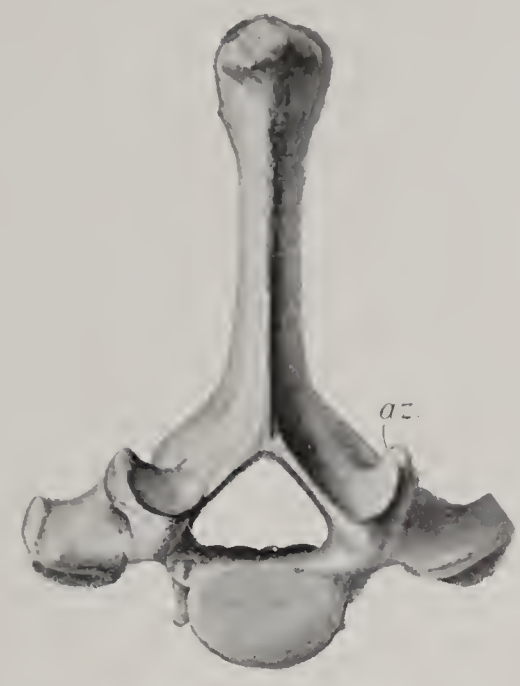

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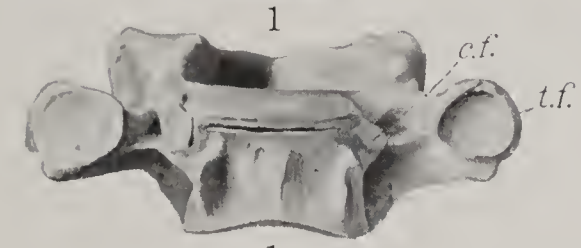

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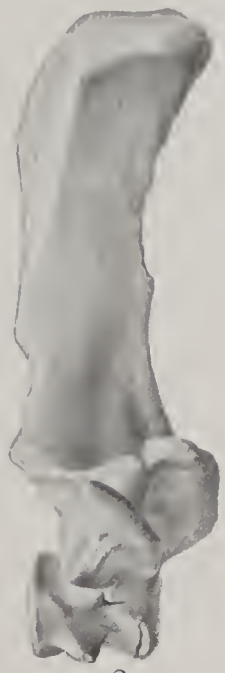

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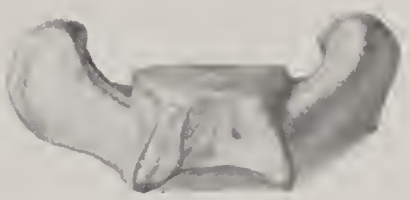

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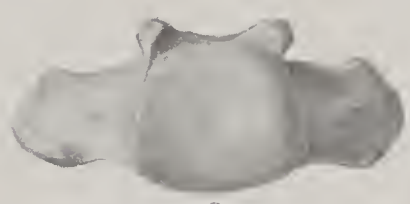

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Megalonyx jeffersonii californicus Stock.

Figs. 1, 1*a*, and 2. First thoracic vertebra, No. 22111 U. C. C. Fig. 1, anterior view; Fig. 1*a*, ventral view; Fig. 2, lateral view; × 0.33; *az*, anterior zygapophysis; *c.f.*, facet for capitulum of rib; *t.f.*, facet for tuberculum of rib.
Figs. 3 and 4. Anterior thoracic vertebra, No. 24243 U. C. C. Fig. 3, anterior view; Fig. 4, lateral view. × 0.33.
Figs. 5 and 6. Posterior thoracic vertebra, No. 24244 U. C. C. Fig. 5, anterior view; Fig. 6, lateral view. × 0.33.
Figs. 7, 7*a* and 8, 8*a*. Two caudal vertebrae, Nos. 6003–1, 6003–2 L. A. M.; anterior and dorsal views. × 0.33.
Specimens referred tentatively to *M. j. californicus*.
Los Angeles Mus. and Univ. California Collections. Rancho La Brea Pleistocene.

Megalonyx jeffersonii californicus Stock.

Figs. 1, 1*a*, and 1*b*. Left humerus, No. 21003. Fig. 1, anterior view; Fig. 1*a*, view of proximal end; Fig. 1*b*, view of distal articulation. × 0.50.

Fig. 2. Left humerus, No. 21003, inner view. × 0.50.

Univ. California Collection. Rancho La Brea Pleistocene.

Megalonyx jeffersonii californicus Stock.

FIGS. 1, 2, and 3. Left ulna, No. 23192. Fig. 1, outer view; Fig. 2, inner view; Fig. 3, radial view. × 0.50. Univ. California Collection. Rancho La Brea Pleistocene.

Mylodon harlani Owen.

Dermal ossicles. × 1. Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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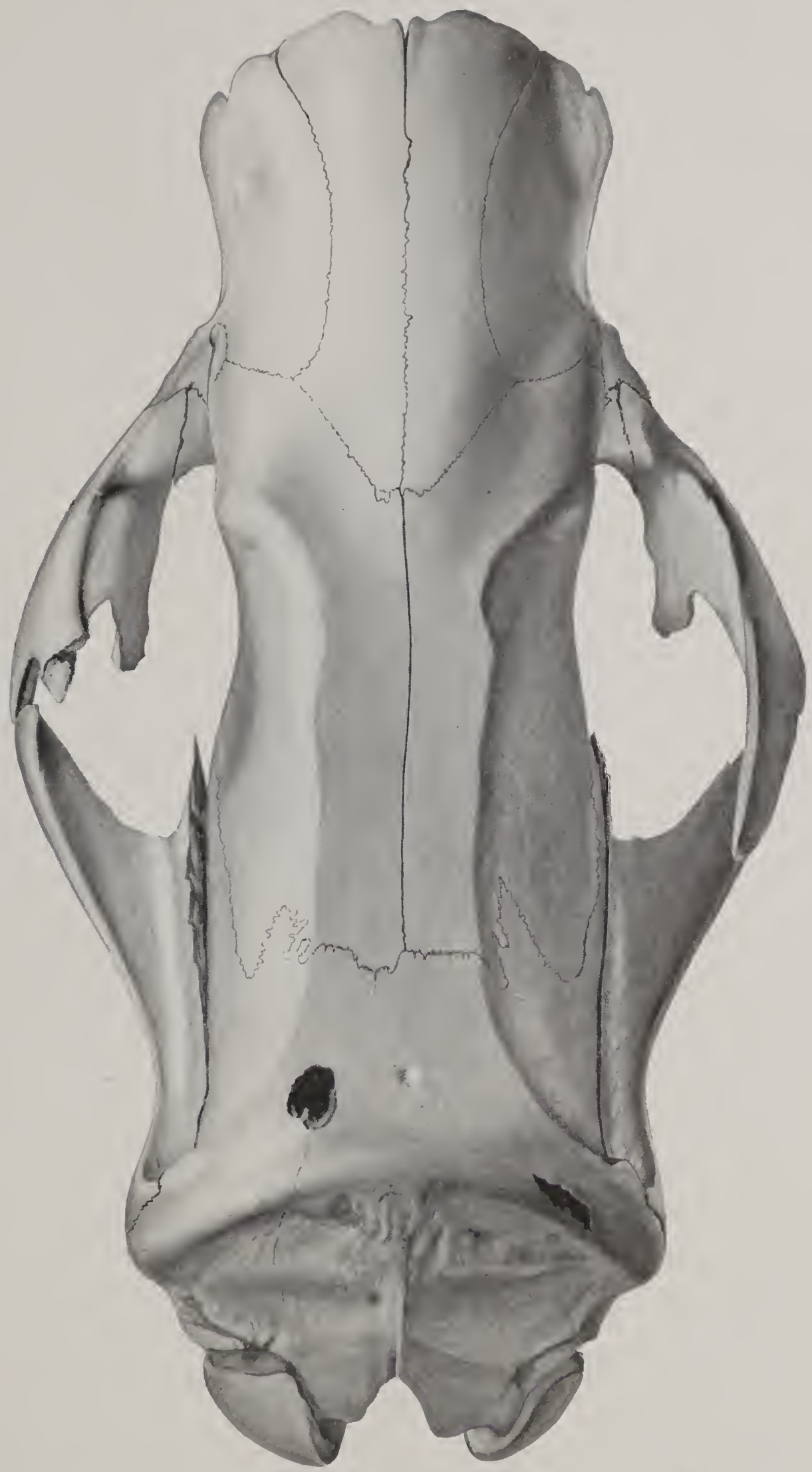

Mylodon harlani Owen.

Skull, No. 1717–32, dorsal view. × 0.40. Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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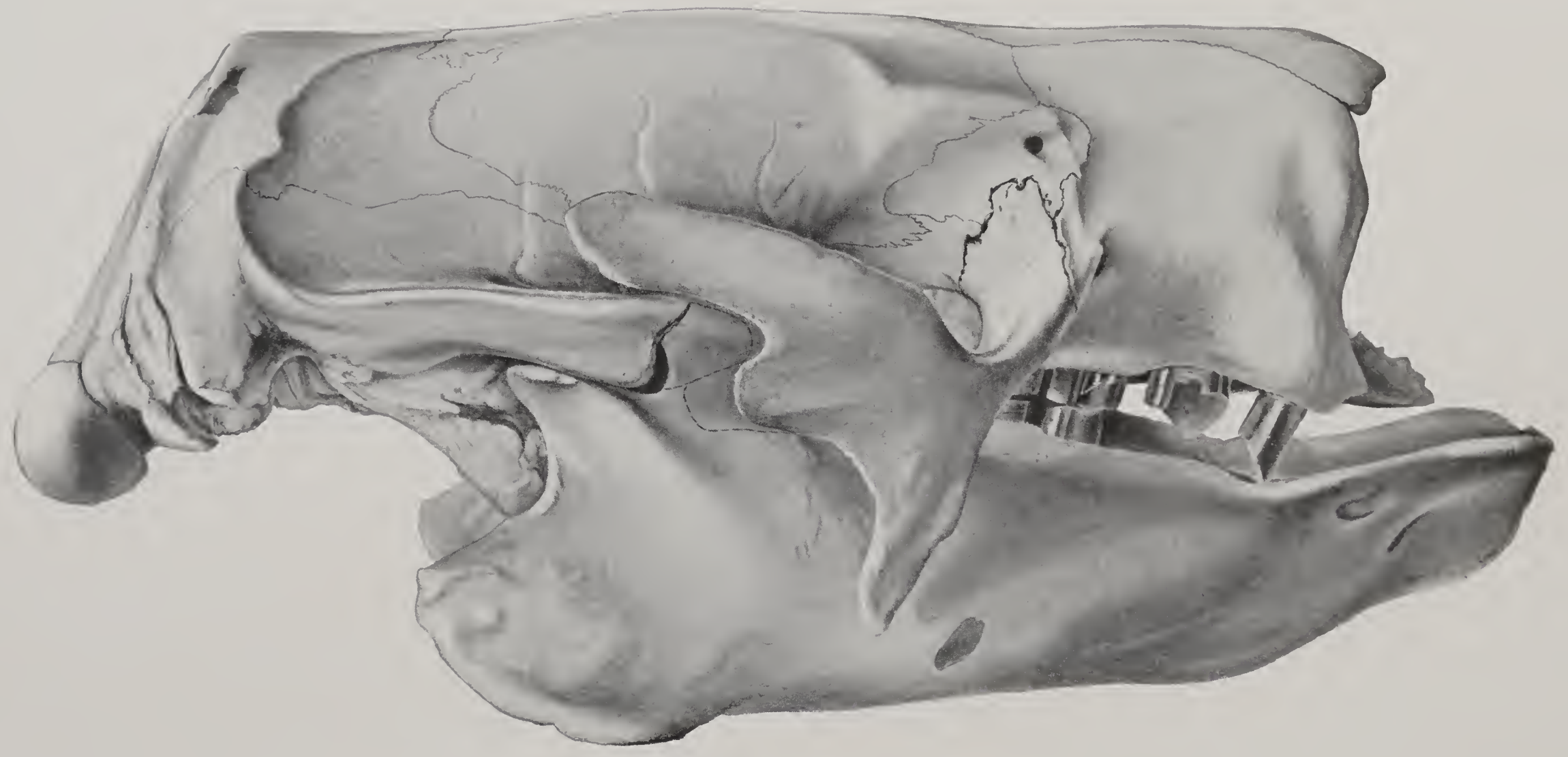
Mylodon harlani Owen.

Fig. 1. Skull, No. 1717–32, ventral view. × 0.40.
Fig. 2. Premaxillaries, ventral view. × 0.40.
Fig. 4. Right incus. × 2. Fig. 3. Left malleus. × 2.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

PLATE 24



Mylodon harlani Owen.

Skull and mandible, No. 1717–32 and No. 1718–1, lateral view. × 0.40.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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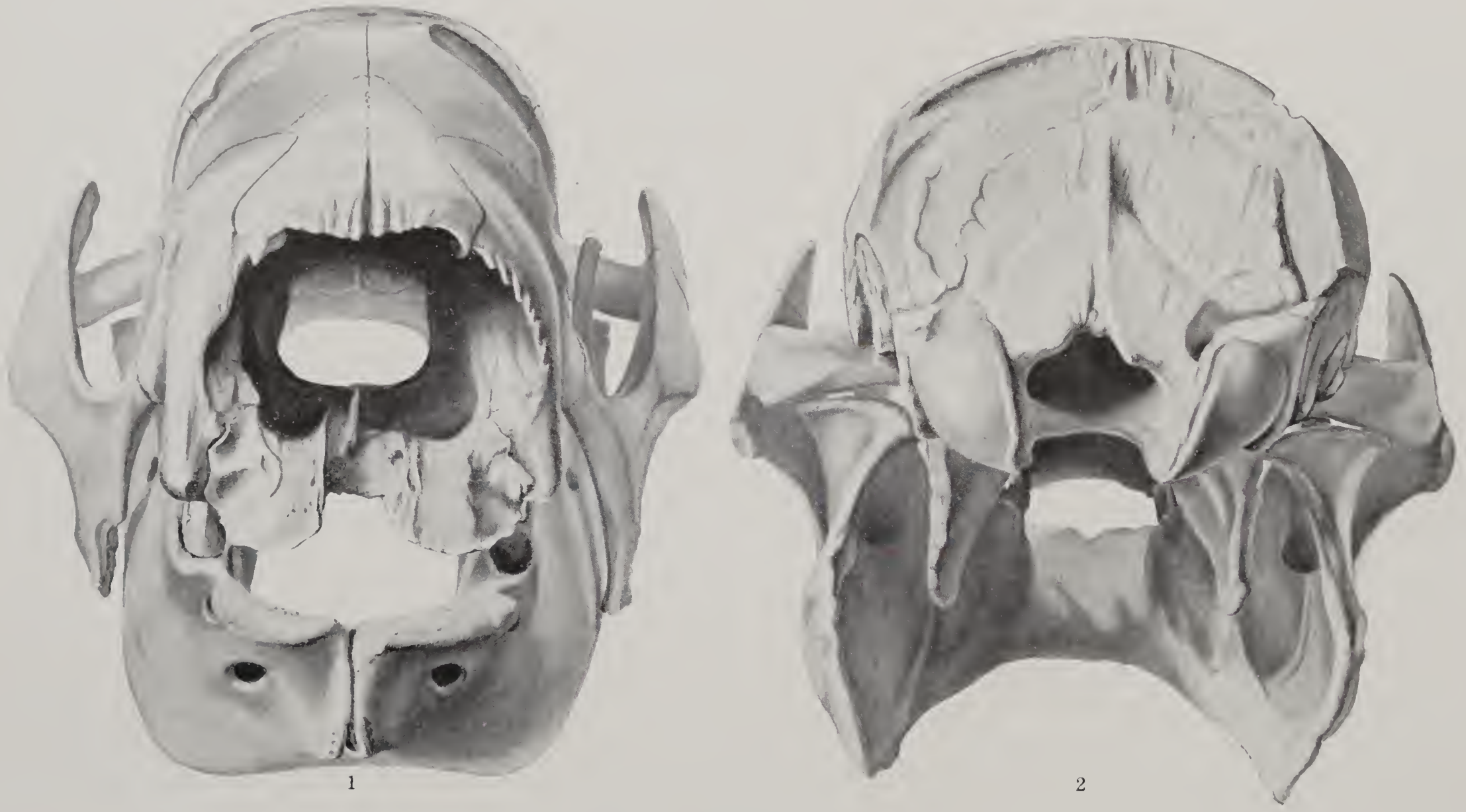
PLATE 25



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Mylodon harlani Owen.

FIGS. 1 and 2. Skull and mandible, No. 1717–32 and No. 1718–1. Fig. 1, anterior view; Fig. 2, posterior view. × 0.40.
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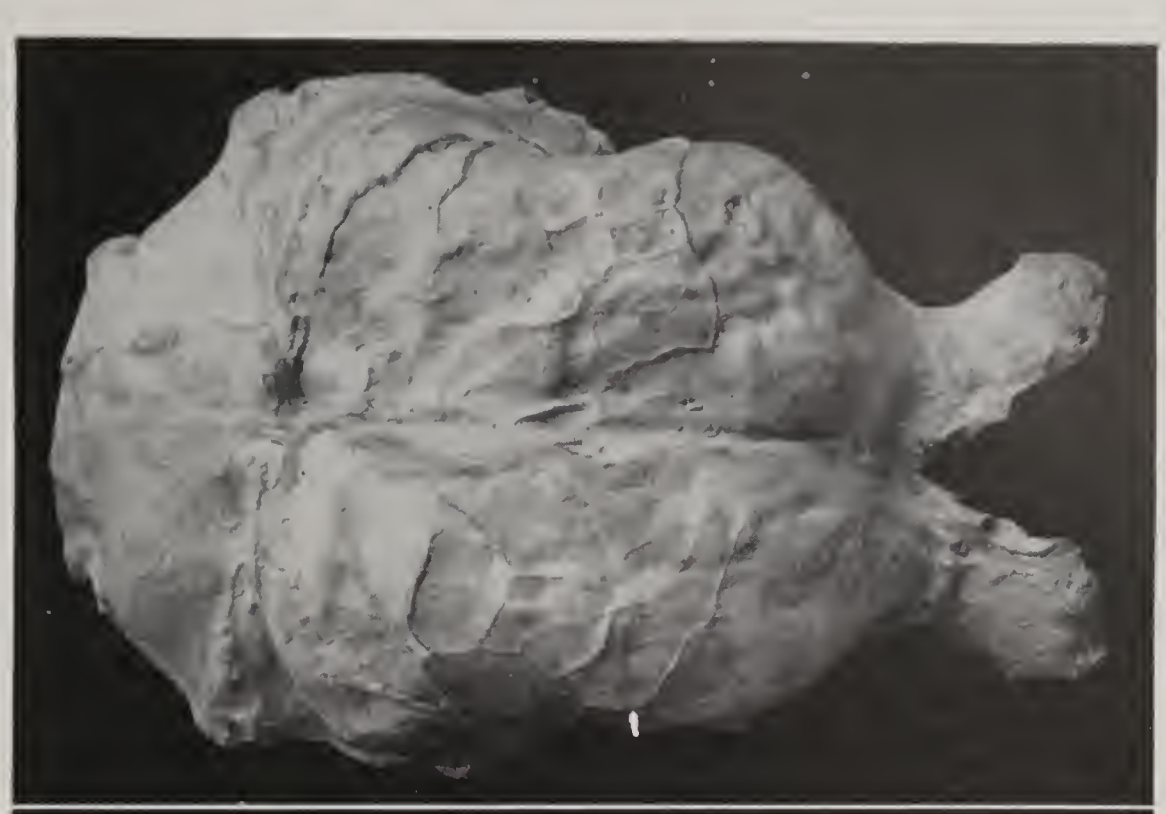

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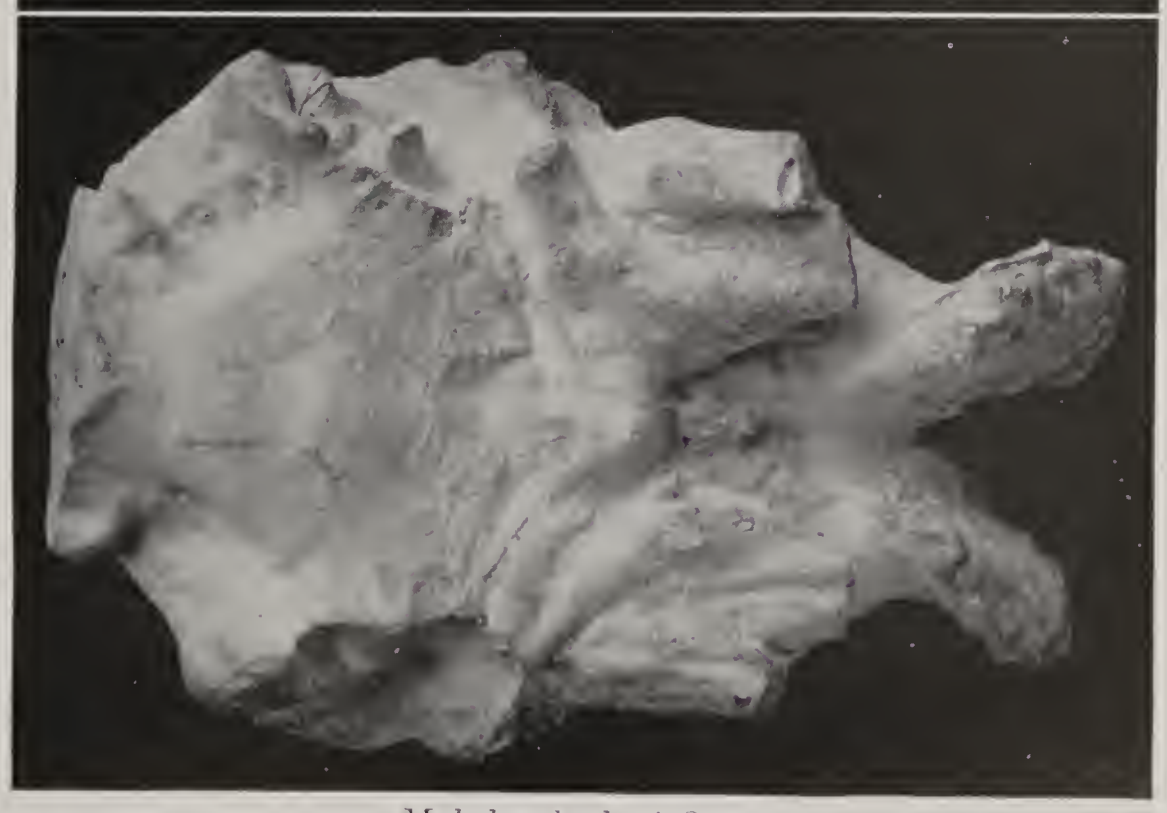

Mylodon harlani Owen.

FIGS. 1, 2, and 3. Endocranial cast. Fig. 1, dorsal view; Fig. 2, lateral view; Fig. 3, ventral view. × 0.75.

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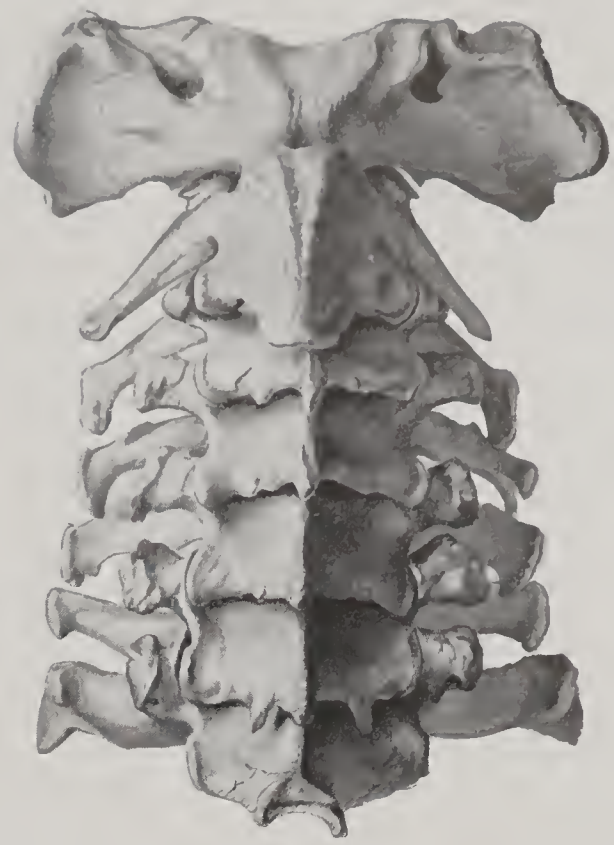

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Mylodon harlani Owen.

Fig. 1. Mandible, No. 1718–1, dorsal view. × 0.40.

Fig. 2. Hyoid arch, lateral view. × 0.40. *Sh*, stylohyal; *ch*, epihyal; *ch*, ceratohyal; *bh*, basihyal; *th*, thyrohyal; *tc*, ossified thyroid cartilage.

Figs. 3 and 4. Cervical vertebrae I–VII. Fig. 3, dorsal view; Fig. 4, lateral view. × 0.25.

Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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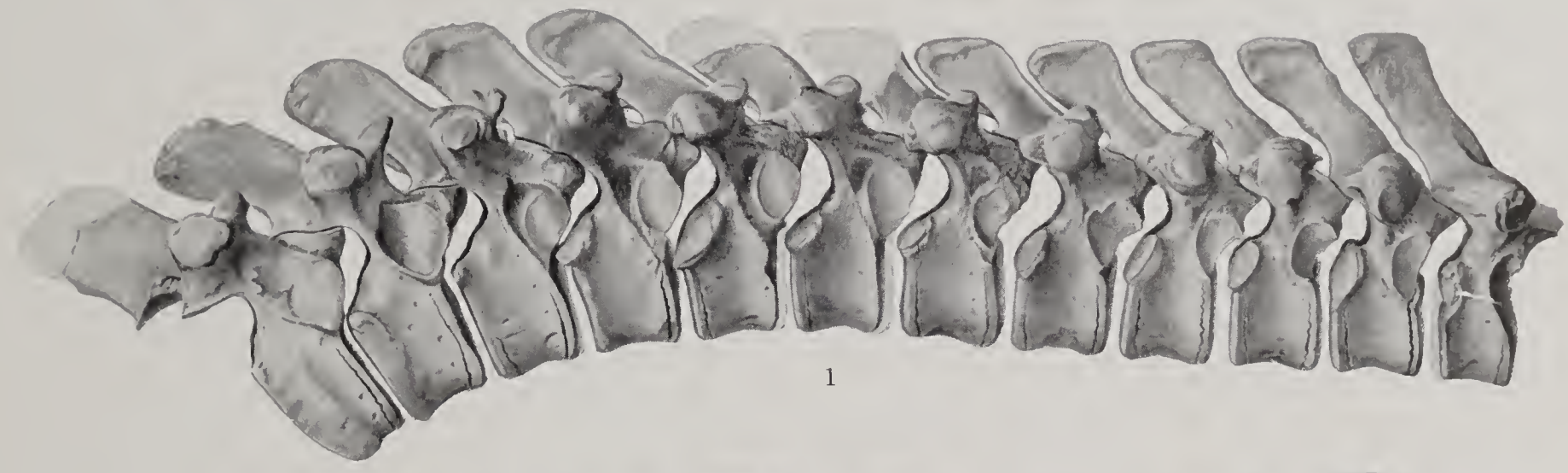

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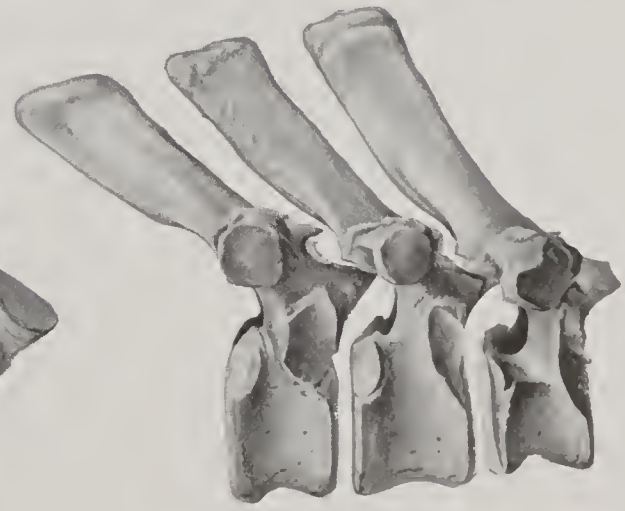

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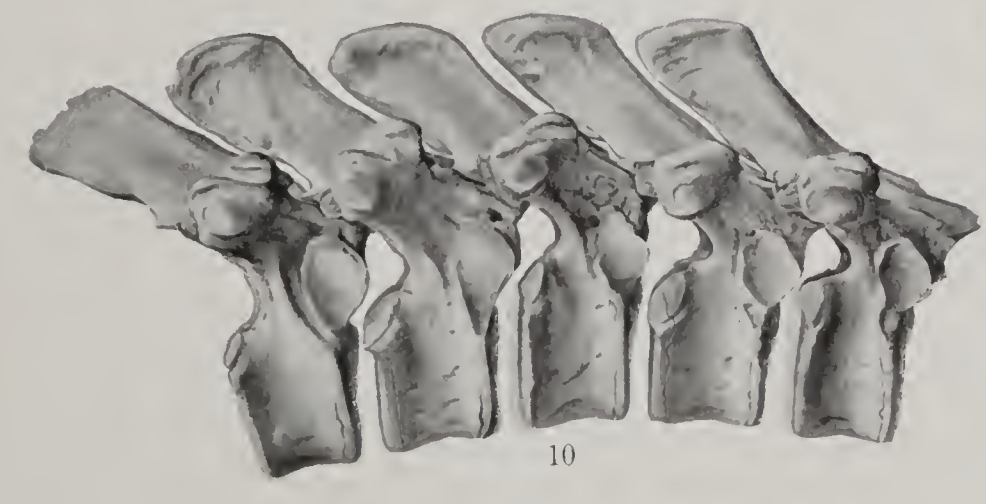

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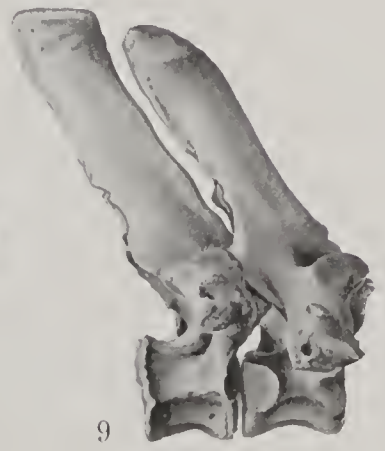

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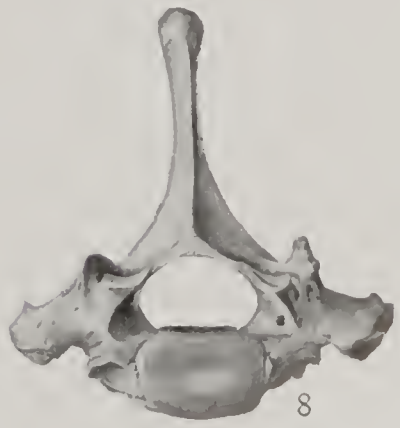

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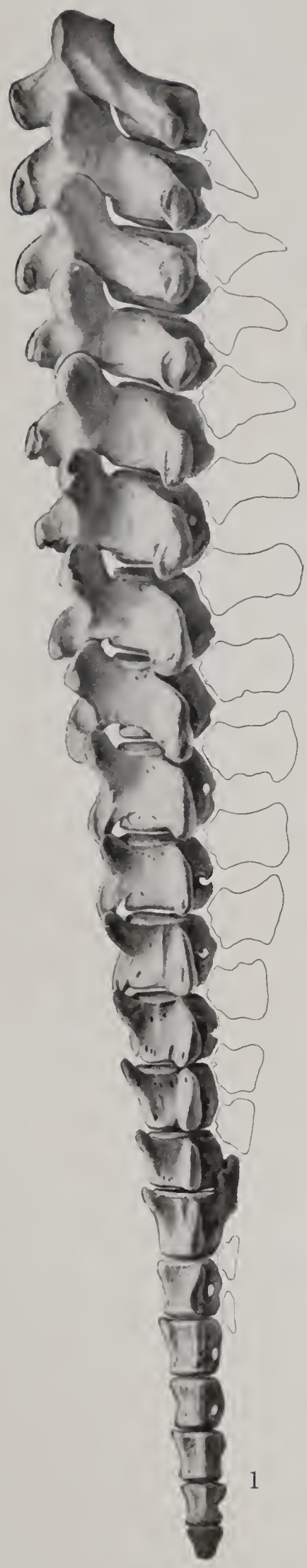

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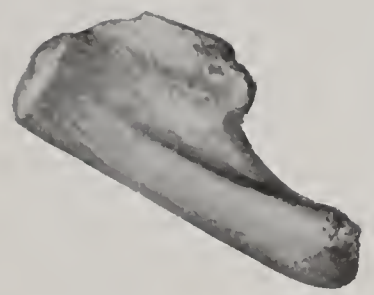

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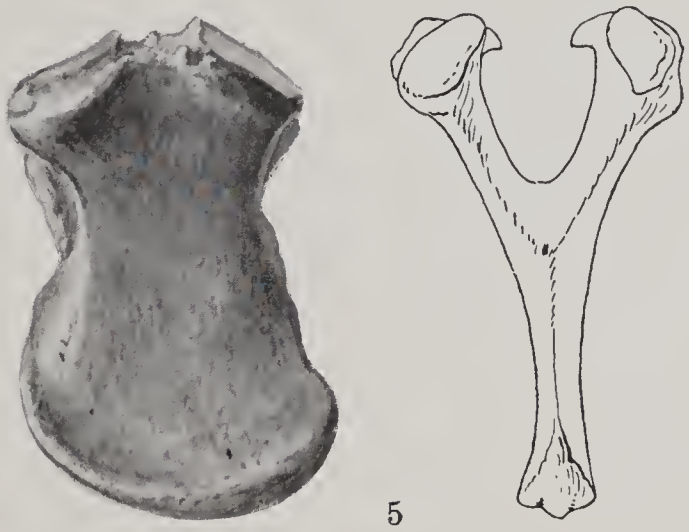

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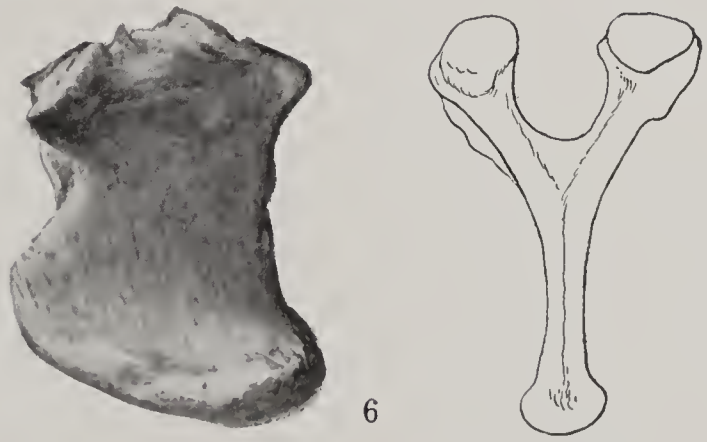

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Mylodon harlani Owen. Caudal vertebrae and Haemapophyses.

Figs. 1 and 2, × 0.20; Figs. 3 to 7, × 0.50.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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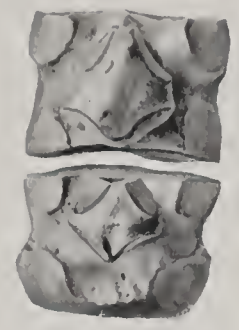

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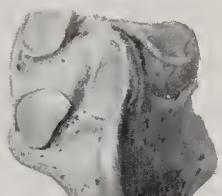

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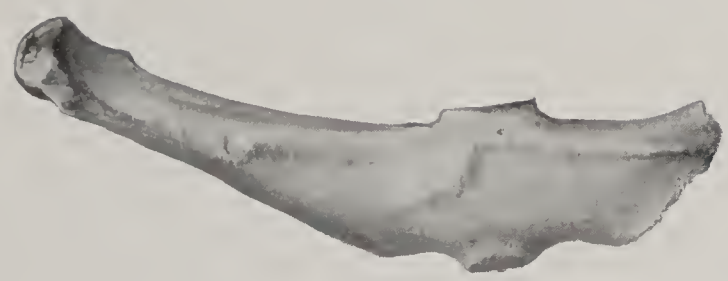

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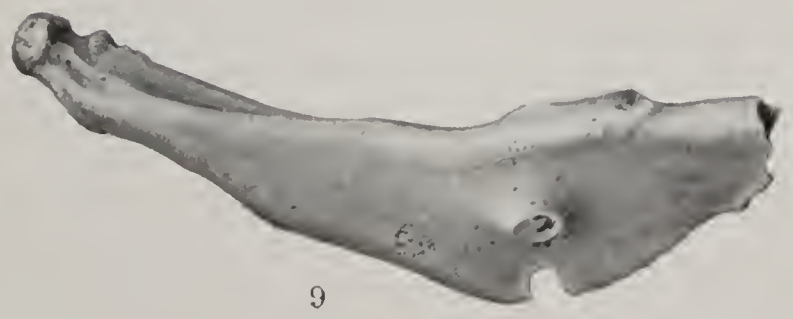

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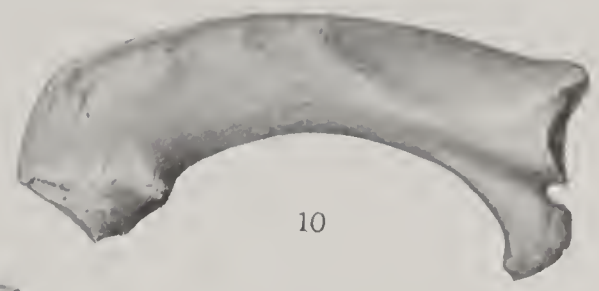

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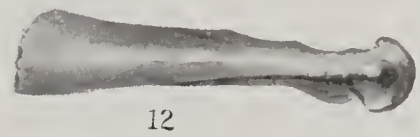

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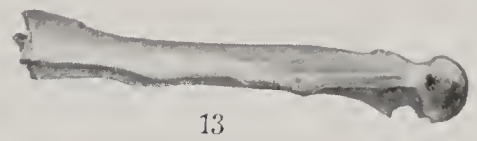

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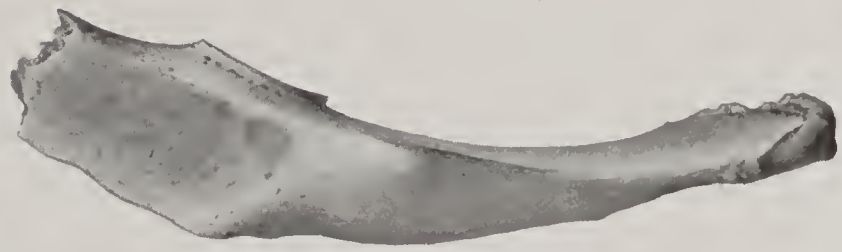

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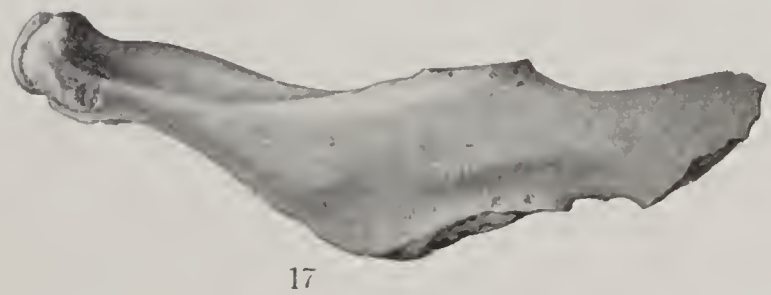

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Mylodon harlani Owen.

Sternal segments and sternal ribs. × 0.25.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

1

2

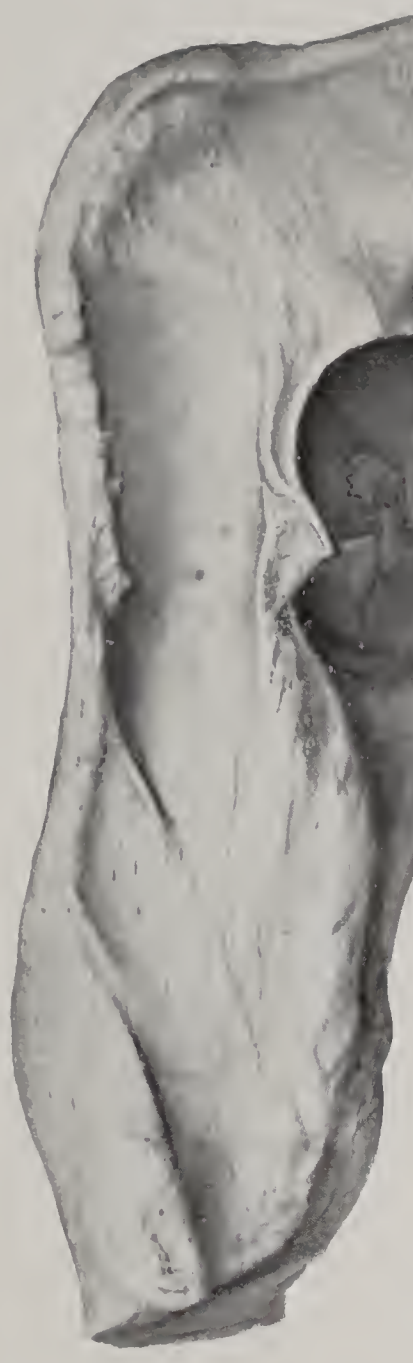
1a

Mylodon harlani Owen.

FIGS. 1 and 1 *a*. Right scapula, No. 1715–R–15. Fig. 1, outer view; Fig. 1*a*, view of proximal end. × 0.33.
FIG. 2. Right clavicle, No. 1738–R–1, anterior view. × 0.33.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.

Mylodon harlani Owen.

FIGS. 1 and 1*a*. Right humerus, No. 1712–R–1. Fig. 1, posterior view; Fig. 1*a*, view of proximal end. × 0.33.
FIGS. 2 and 2*a*. Right humerus, No. 1712–R–1. Fig. 2, anterior view; Fig. 2*a*, view of distal end. × 0.33.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.



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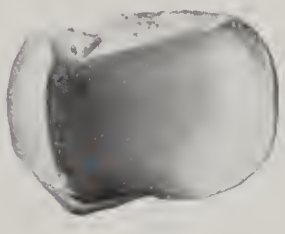

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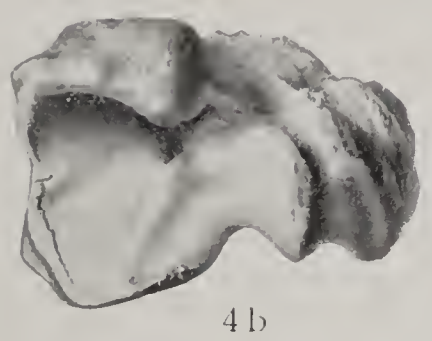

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Mylodon harlani Owen.

Figs. 1, 2, and 3. Right ulna, No. 1714–R–27. Fig. 1, outer view; Fig. 2, inner view; Fig. 3, radial view. × 0.33.

Figs. 4, 4*a*, and 4*b*. Right radius, No. 1713–R–3; Fig. 4, anterior view; Fig. 4*a*, view of proximal articulation; Fig. 4*b*, view of distal end. × 0.33.

Fig. 5. Right radius, No. 1713–R–3, ulnar view. × 0.33.

Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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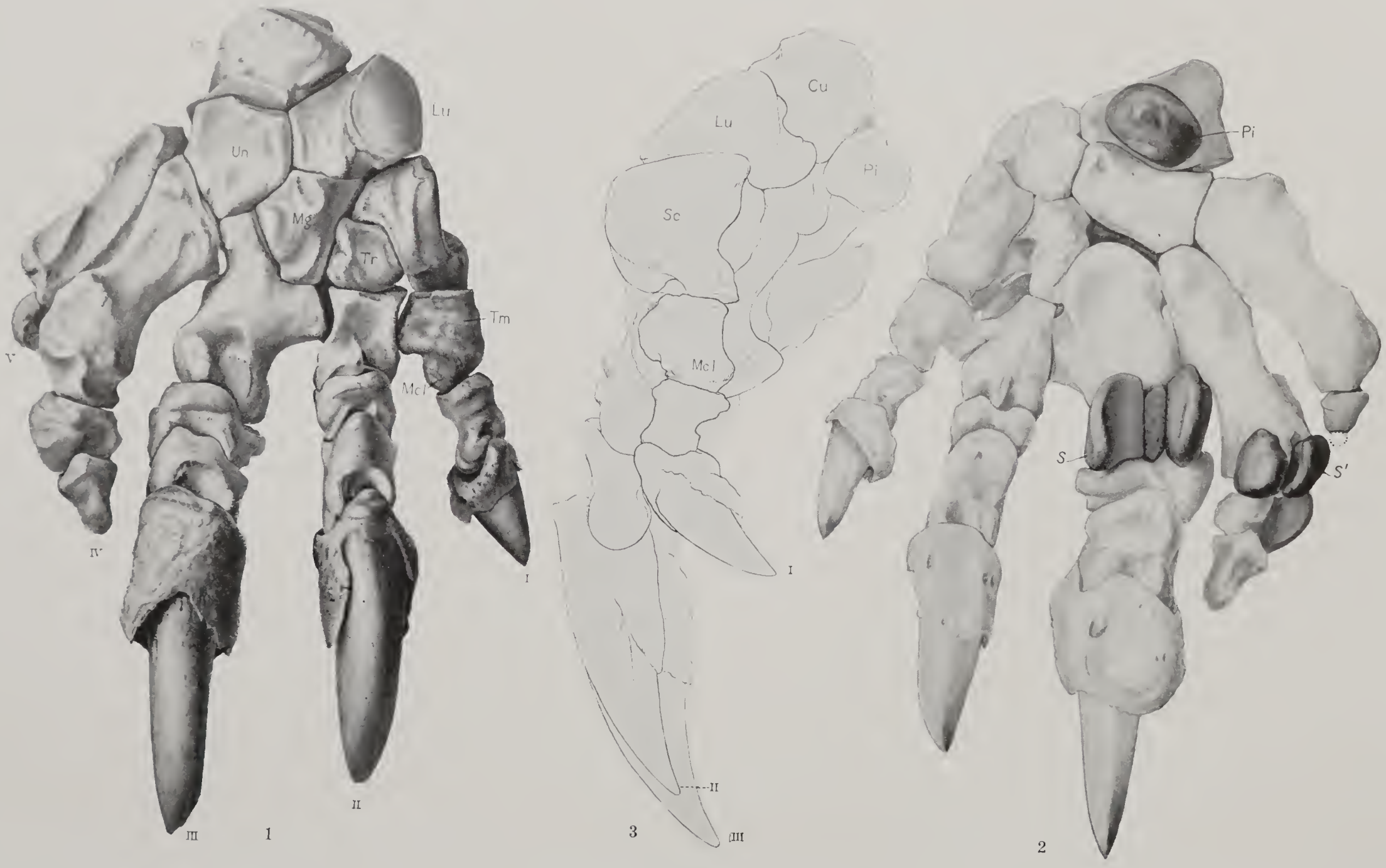

Mylodon harlani Owen.

Fig. 1. Right manus, dorsal view. × 0.33. *cu*, cuneiform; *lu*, lunar; *un*, unciform; *mg*, magnum; *tr*, trapezoid; *tm*, trapezium; *mc* I, first metacarpal; I, II, III, IV, V, digits.

Fig. 2. Right manus, palmar view. × 0.33. *pi*, pisiform; *s* and s^1 sesamoid bones of the third and fourth metacarpals.

Fig. 3. Right manus, inner view; *sc* scaphoid; remaining letters and numerals as in other figures. × 0.33.

Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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Mylodon harlani Owen.

Pelvis, No. 1719–1, anterior view. × 0.20.

Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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Mylodon harlani Owen.

Pelvis, No. 1719–1, posterior view. × 0.20.

Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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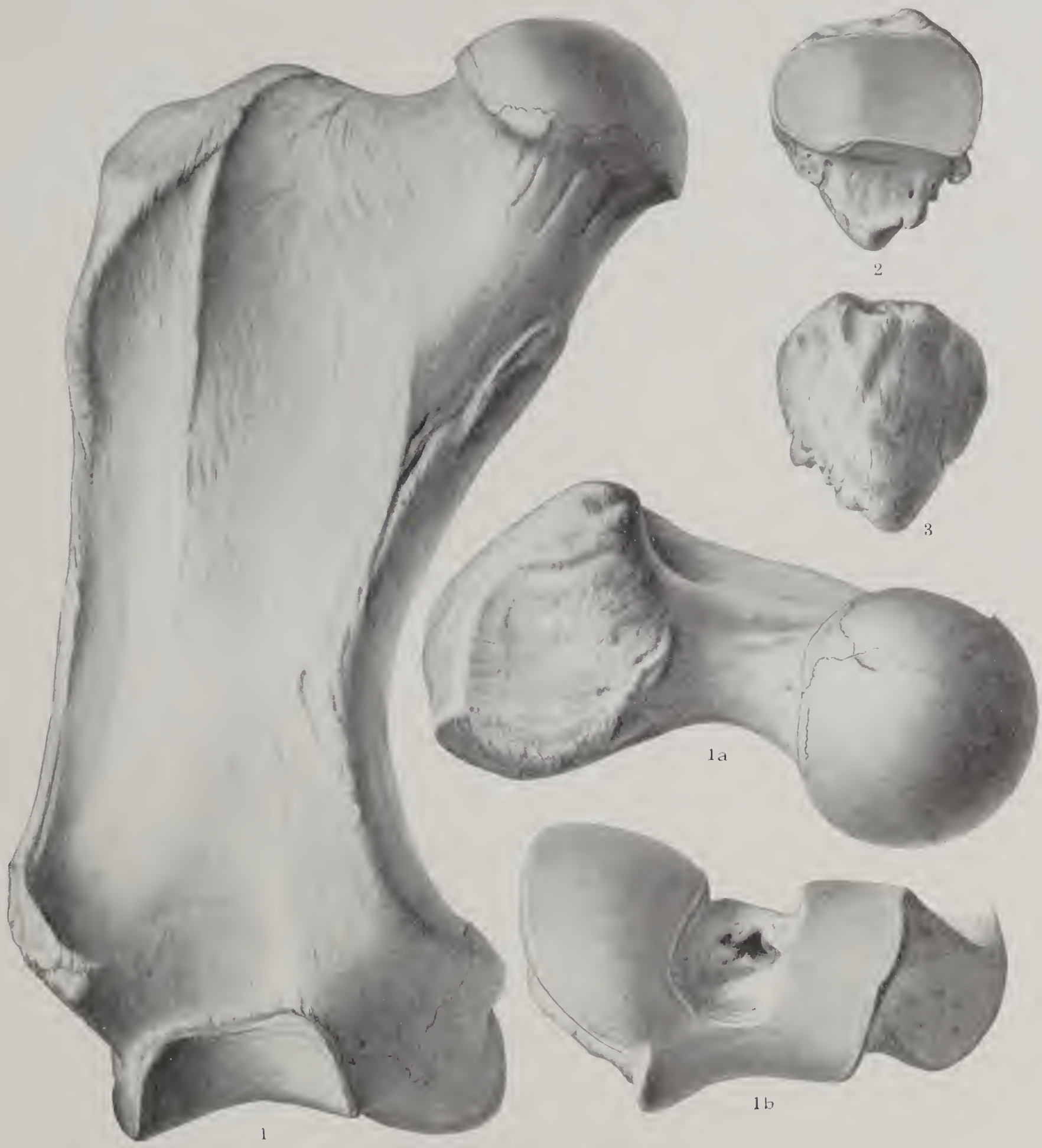
Mylodon harlani Owen.

FIGS. 1 and 2. Pelvis, No. 1719–1; Fig. 1, lateral view; Fig. 2, dorsal view. × 0.20.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.



Mylodon harlani Owen.

FIGS. 1, 1*a*, and 1*b*. Right femur, No. 1704–R–15. Fig. 1, anterior view; Fig. 1*a*, view of proximal end; Fig. 1*b*, view of distal end. × 0.33.

FIGS. 2 and 3. Right patella, No. 1710–R–15. Fig. 2, femoral view; Fig. 3, anterior view. × 0.33.

Los Angeles Museum Collection. Rancho La Brea Pleistocene.

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Mylodon harlani Owen.

FIGS. 1 and 2. Right femur, No. 1704–R–15. Fig. 1, posterior view; Fig. 2, inner view. ×0.33. Los Angeles Museum Collection. Rancho La Brea Pleistocene.

Mylodon harlani Owen

FIGS. 1, 1*a*, and 1*b*. Right tibia, No. 1702–R–5. Fig. 1, anterior view; Fig. 1*a*, view of proximal end; Fig. 1*b*, view of distal end. × 0.33.

FIG. 2. Right tibia, No. 1702–R–5, inner view. × 0.33.

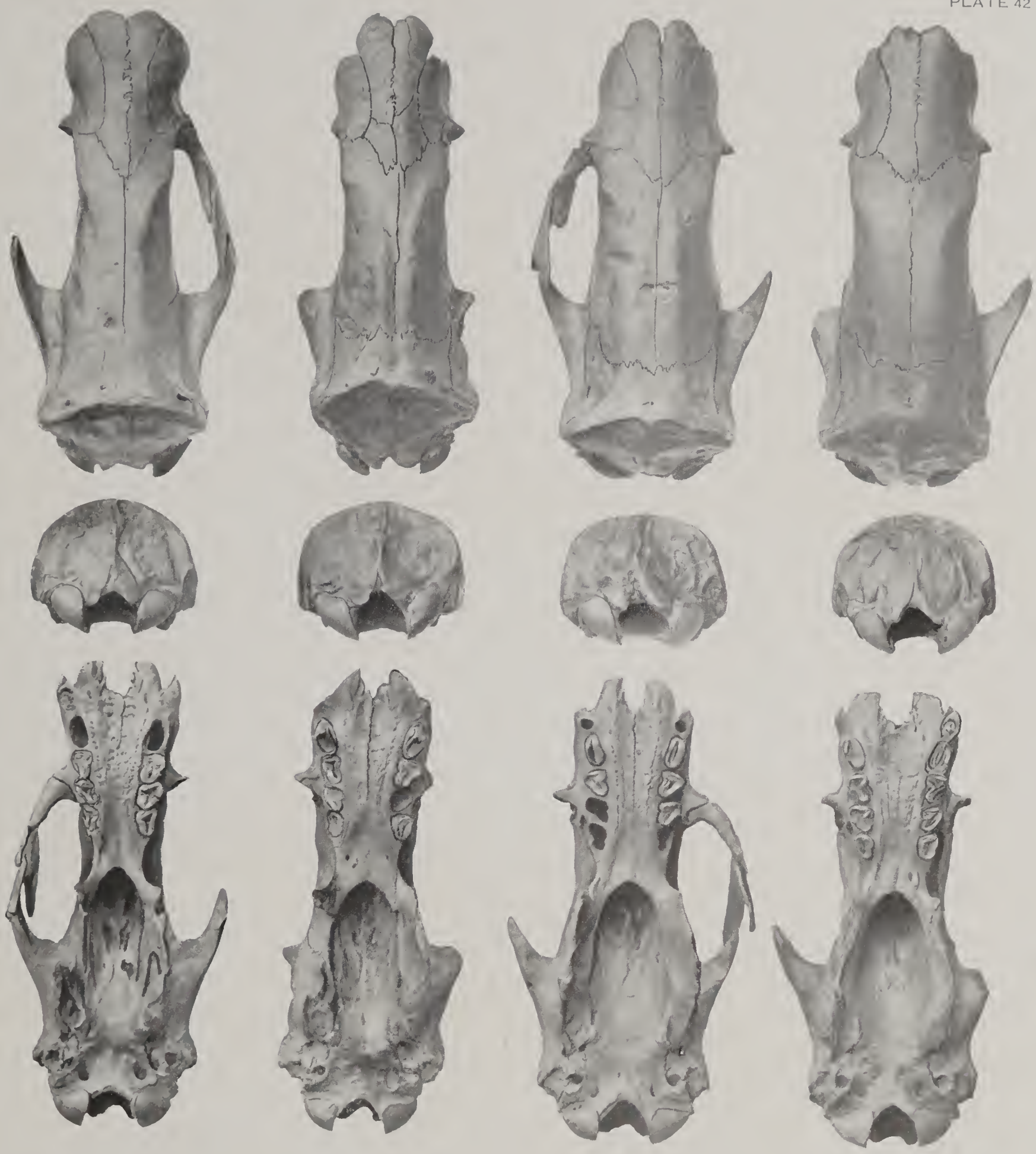
FIGS. 3 and 4. Right fibula, No. 1703–R–7; Fig. 3, tibial view; Fig. 4, outer view. × 0.33.

Los Angeles Museum Collection. Rancho La Brea Pleistocene.

Mylodon harlani Owen.

FIGS. 1, 2, and 3. Right pes. Fig. 1, dorsal (outer) view; Fig. 2, inner (dorsal) view; Fig. 3, plantar (inner) view; × 0.33. *ca*, calcaneum; *as*, astragalus; *cu*, cuboid; *na*, navicular; *ec*, ectocuneiform; *mc*, mesocuneiform; *mt.* II, *mt.* V, second and fifth metatarsals; II, III, IV, V, digits.

Los Angeles Museum Collection. Rancho La Brea Pleistocene.



1 2 3 4

Mylodon harlani tenuiceps Stock.

FIG. 1. Ventral, posterior and dorsal views of skull, No. 1716–1.

Mylodon harlani Owen.

FIGS. 2, 3, and 4. Same views as in Fig. 1. Fig. 2, No. 1717–1; Fig. 3, No. 1717–8; Fig. 4, No. 1717–22.
Los Angeles Museum Collection. Rancho La Brea Pleistocene.
Photographs by L. E. Wyman. Courtesy of Los Angeles Museum.

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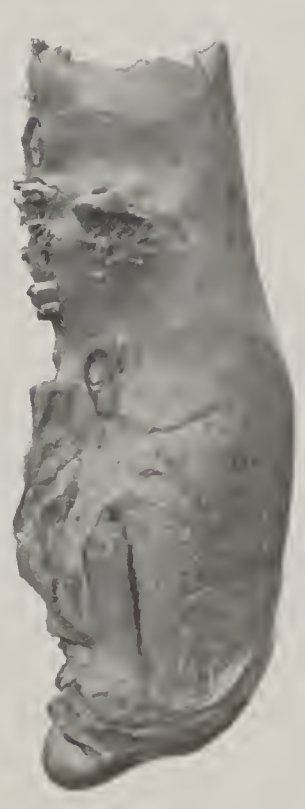

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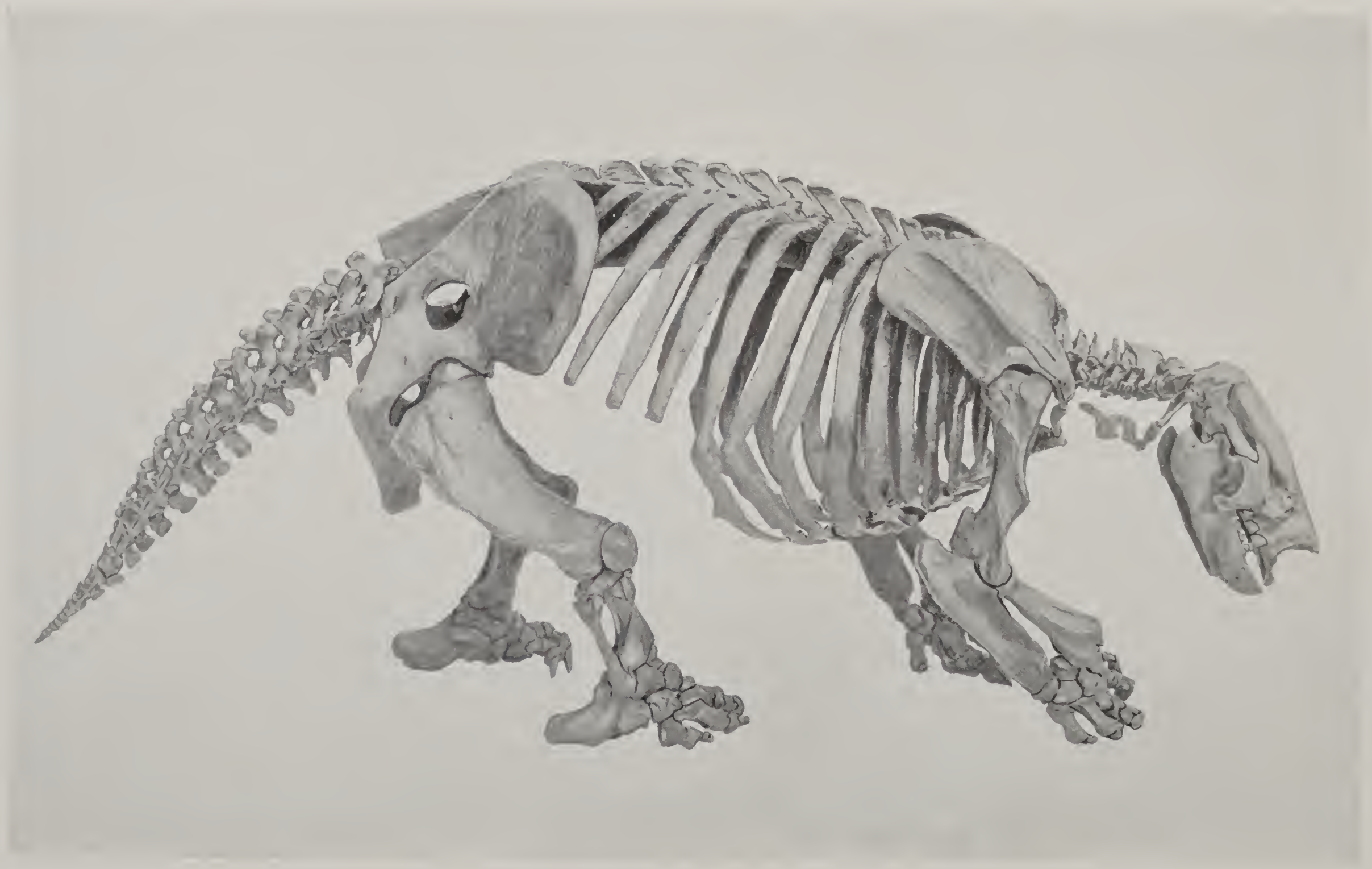
Mylodon harlani Owen. FIGS. 1 to 4. Mandibles, dorsal and lateral views. Fig. 1, No. 1718–20; Fig. 2, No. 1718–21; Fig. 3, No. 1718–29; Fig. 4, No. 1718–3.

Mylodon harlani tenuiceps Stock. FIG. 5. Skull, No. 1716–1, lateral view.

Mylodon harlani Owen. FIGS. 6, 7, and 8. Skulls, Nos. 1717–1, 8, 22, lateral views.

Los Angeles Museum Collection. Rancho La Brea Pleistocene. Photographs by L. E. Wyman.



Mylodon harlani Owen.

Mounted skeleton, view from right side. × 0.077.
Los Angeles Museum Collection. Prepared by J. W. Lytle.
Photograph by L. E. Wyman. Courtesy of Los Angeles Museum.

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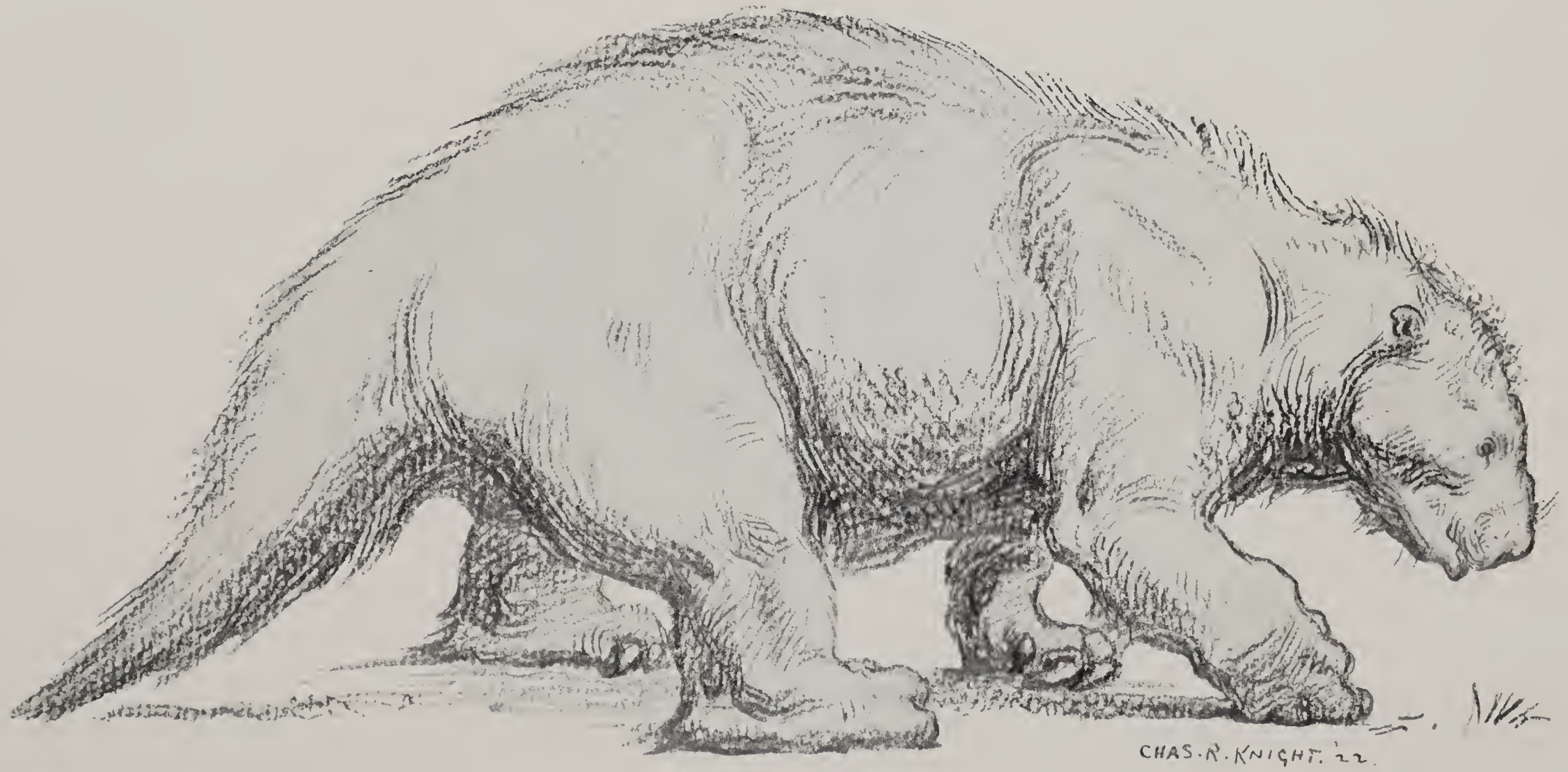
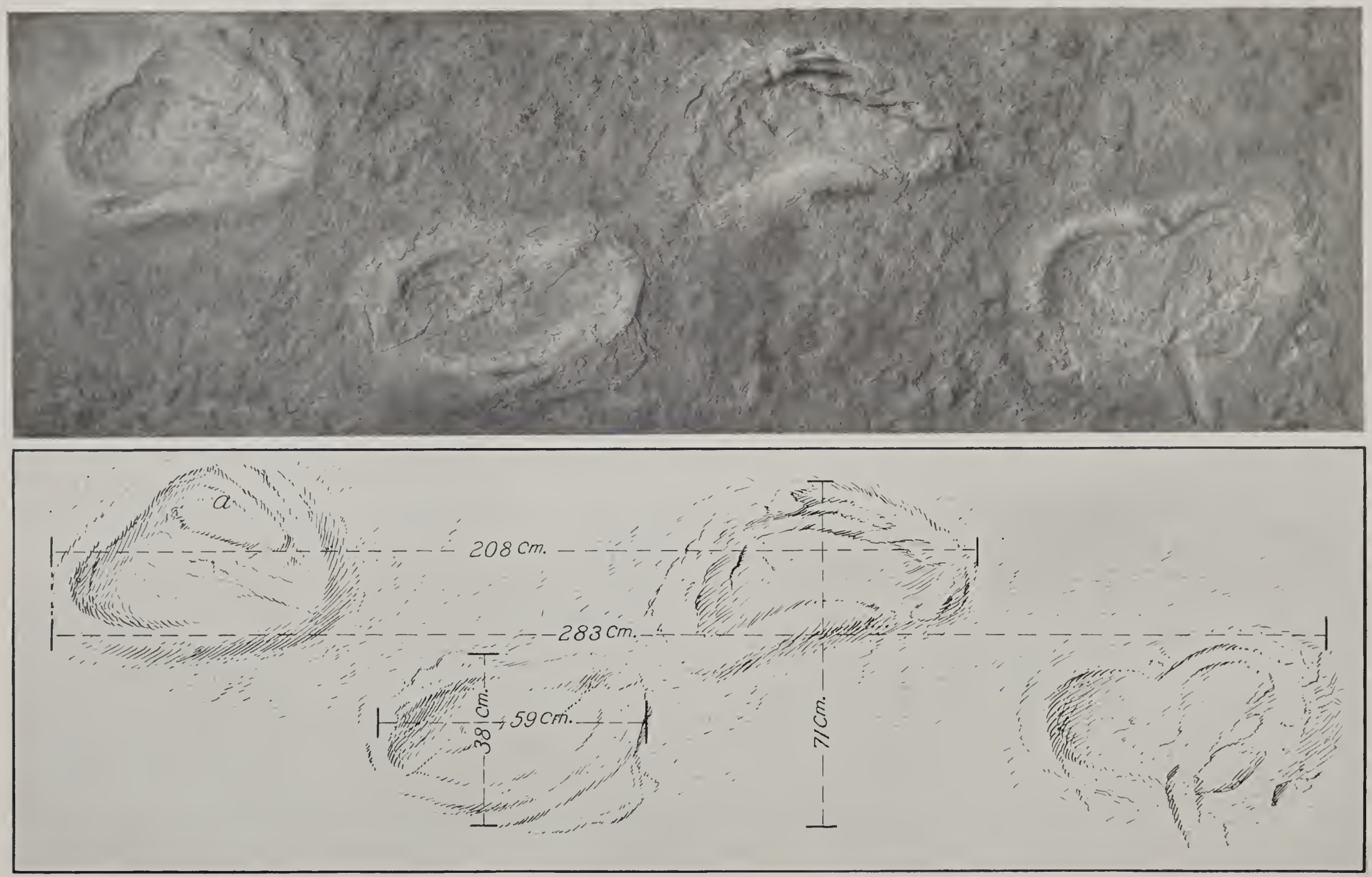


Mylodon harlani Owen.

Restoration by Charles R. Knight under the direction of Chester Stock.



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Mylodon harlani Owen.

Replica of footprints in Pleistocene deposits at the Nevada State Penitentiary, Carson City, Nevada. Diagram indicates size of imprints, length of stride, and width of straddle. Cast prepared by J. W. Lytle.

a, possible impression of ungual phalanx, digit III, manus. Los Angeles Museum Collection.

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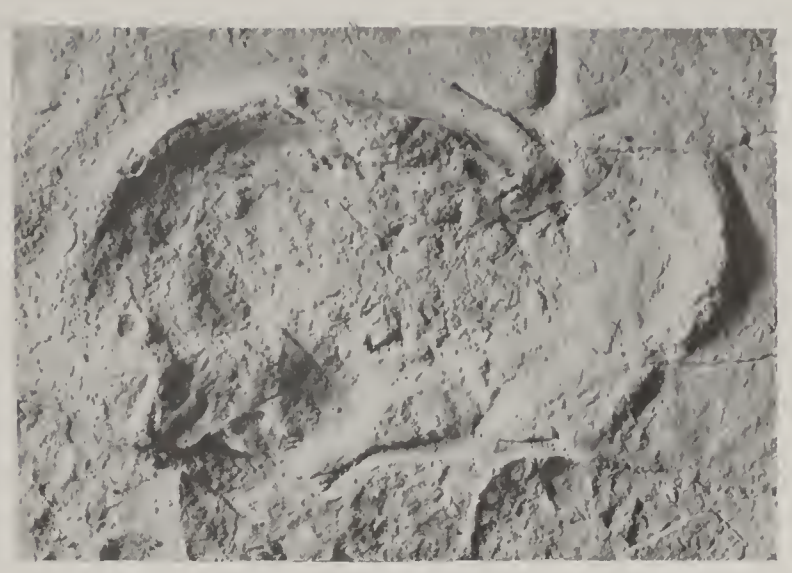

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Mylodon harlani Owen.

FIGS. 1 to 6. Footprints on floor of tunnel in east wall of prison yard, Nevada State Penitentiary, Carson City, Nevada.

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